THE

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ELECTRICAL REVIEW.

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THE BRITISH ASSOCIATION.

THE summer meeting of the Institution of Mechanical Engineers, which commenced on Monday last, was not over before the British Association for the Advancement of Science commenced on Wednesday, at York, its seventy-sixth meeting. For people who regard these meetings as affording relaxation, the August holiday is quite a convenient period. In any case, it probably suits the majority; but it is a pity that the two meetings clash with one another, as it may prove inconvenient to those engineers who desire to attend Section G. Prof. Ewing is to preside over the Engineers, and we observe that many well-known men are expected to take part in the discussion of the papers, which are interesting and varied.

The meeting bids fair to be a success, and the Parliament of Science will find York a most satisfactory place for its deliberations, and even for its picnics. We trust that no one connected with Section G, or with the ruling circles of the Association, will think us ungracious if we take the opportunity while the meeting is proceeding to indulge in a little criticism and to make a few suggestions.

We have heard it stated over and over again that Section G is an anomaly, and that it ought to be swept away. It is said that the British Association is for pure science, and that engineering is outside its proper sphere.

Certainly it has often seemed to us that the Section is treated rather like a poor relation. Take, for instance, the Report. In the volume recently issued, out of 616 pages only 20 pages are devoted to this Section, and of these 11 are taken up by the President's address. There is not a single diagram or illustration, although the papers are entitled "Dutch Architecture," "Steam Turbines," "Roller Bearings," "Motor Cars," and so forth.

In several cases merely the titles and the authors' names are given, and in others only the briefest summary—of little or no use to anybody. In former volumes we have seen references to the numbers and dates of technical journals in which the papers might be read, so the report might be said to amount to at least a satisfactory index. In the volume before us even these references seem to have been omitted, with one exception, where the name of a technical journal is cited, but no number or date is given. Thus the whole of the labours of Section G were lost to the majority of the members of the Association, and were available only to the fortunate few who went on that memorable tour in South Africa.

We venture to suggest that as long as the mechanical section is maintained it should be better reported, as otherwise we hardly see how first-class papers can be looked for.

We frequently hear that the best are not available to the British Association, in spite of its splendid traditions and influence; but that they are reserved for the special societies, where at least a tolerable record is kept. Thus it often happens that Section G is almost deserted, only some two or three of the faithful lingering to hear long-winded papers of the advertising order, which constitute no advancement of science, nor even—did they but realise it—of the authors.

For ourselves, we should not much regret it if Section G were swept away, so that those engineeers who attended the British Association's annual meeting could, with an easy conscience, devote themselves to the various kindred branches of science with great refreshment and advantage.

Short of this drastic course, we recommend the exclusion of all papers not considered to be of sufficient interest and value to be reported in full, with illustrations, in at least one technical journal. The report should then give sufficient information for ready reference to the full text and the discussion on it, and at least a readable summary of the paper.

We hold strong views on the multiplying of meetings and the reading of papers. We look forward to a kind of Millennium, when each member of a society will receive an advance copy of the paper, and when the whole time of the meeting will be devoted to discussion, spirited, earnest, even heated, so as to infuse some life into the proceedings.

The papers will be very carefully selected, and the rejections will be many. The honour of having a paper discussed will be eagerly sought after, and the presidencies and vice-presidencies and the memberships of councils, and, in fact, the "laurels," will be for the champions in such debates. The young men will be discovered and brought forward, and some of the old ones will cheerfully give place to them. Youth will be served!

Wild versus "Planted" Rubber.

A letter which appeared in the *Pall Mall Gazette* on July 23rd under the above heading, signed "Globe Trotter," raises some interesting points as to the cultivation of the Hevea braziliensis in Ceylon and the Straits Settlements, which should receive due consideration from would-be investors in this industry. The writer states that this rubber tree is of all the most delicate, and that some of the conditions under which it is expected to flourish and produce remunerative quantities of latex are about as opposed to those existing in its natural habitat as it is possible to imagine. In addition, he doubts whether the fact that trees planted 20 or more years ago in picked positions have apparently adapted themselves to their surroundings, is to be taken as any criterion as to how plantations on a large scale with closely planted trees are likely to turn out.

As to investments in Brazilian rubber forests, he is still less encouraging, and here we are entirely with him. We wonder whether the directors of a company which was recently put before the public are acquainted with the history of the several other older companies of the same kind, and how they propose to get over difficulties which in the past have proved insurmountable. No one but a native-born Brazilian can hope to stand the climate of the Upper Amazon and to manage the rubber gatherers and the business generally, and these gentlemen, though possibly no worse than many Europeans who have come under the corrupting influence of india-rubber, are much more likely to look after their own interests than their employers'. We have on several occasions spoken favourably of the prospects of rubber cultivation in the East, and still think that investments made in this with caution should prove satisfactory; but we would be most emphatic in advising our readers to have nothing whatever to do with anything of the sort in Brazil.

Pushing the Sale of Electricity.

One of the most important electricity supply tendencies in the States at the present time—if we may judge from the great attention which is being given to the question by all of our American electrical contemporaries — is to pay more regard than formerly to the selling of electricity. All sorts of ideas and schemes are being put forward for the commercial central station man to consider in connection with new schemes for pushing his sales of energy. Here in this country, too, equally energetic action is being taken, though with perhaps a little less shouting. It is now felt that the man who has sufficient knowledge of the technical side of the business and is at the same time capable of organising and managing a selling department, and can push advertising and publicity work with resource, tact and discretion, so as to catch the interest and patronage of the consuming public is at the point of becoming —dare we say it?—quite as essential to the success of an electric light and power concern as the highly skilled and qualified station engineer. We had an idea that in this particular direction—the commerce of electricity supply—American works were far more advanced than we in the old country. But we hardly know now whether that is correct, for we have before us comments made in two of our American exchanges which are not altogether in agreement on the point. The *Western Electrician* is pleased, in editorially referring to some remarks made by an American visitor to this side of the Atlantic, to say that Englishmen's lack of enthusiasm is shown most noticeably in the matter of procuring central station business. It continues:—

> As a rule the English central stations are abreast, if not ahead, of ours in the matter of equipment, but how to make this expensive equipment pay for itself by the extension of profitable business seems to be a greater problem to the average British central station manager than plant design. . . . As to going out after new business—it is a thing unthinkable. The corporation-owned properties are the worst of all, though the limited companies are bad enough in this respect.

This is edifying, whether it be true or not. But the same mail brought us a copy of the *Electrical World*, where, also editorially, we find a somewhat different position taken up. We quote:—

> A municipal plant in the United States, which is pushing for new business in the same way as a central station corporation, would be such a novelty as to attract universal attention. The general policy of municipally-owned electric light plants in the United States has been that of taking what business comes to it, provided the plant has capacity to care for it, and letting the matter go at that. It has often been pointed out that municipally-owned and operated electric light plants in Great Britain are hardly to be compared with those in the United States, owing to radical differences in conditions. . . . While we are led to judge that business-getting campaigns among English municipal plants are not common, yet there is, nevertheless, much more interest taken in this subject than among American municipal plants. In fact, the whole tone of these papers (read before the M.E.A.) indicates that British municipal plants are operated more in the interests of their owners than are American municipal plants, and consequently their management corresponds very closely to that of fairly progressive private companies.

We attach little weight to what the *Western Electrician* says regarding English backwardness; it has so often found so much in this poor old country to decry. It is a surprising concession to learn from that quarter that our stations are even "abreast, if not ahead of" theirs in the matter of equipment. But, after all, we cannot see what is to be gained in a matter of this sort by the use of general depreciatory terms. The electricians of the two countries have to deal with this publicity and electricity selling in their own way; there are different sets of conditions and different classes of public, and they have to find out the best way to adapt themselves to meeting these conditions and people so as to win in the competition with other illuminants. The result aimed at is everywhere a bigger custom, and in obtaining that result the interchange of ideas between our own electricity works officials and our American cousins, might be made to play an important part.

A paragraph is going the round of the daily newspapers on this side, showing how much less electricity is used per head in London than in New York, but the reasons are not stated; for one thing we believe that the gas competition which has to be met here is infinitely larger and more firmly established than that encountered by the electricity supply authorities in New York, both in regard to lighting and heating.

The gross misrepresentations and the half-truths which emanate from gas quarters here in regard to street and private lighting, require very vigorous refutation by the commercial staff of an electricity supply undertaking. This is one of the chief duties that must immediately devolve upon any man who takes up canvassing for the sale of electricity. According to the present indications, he is to have before long whatever assistance he may be able to obtain from an extension of municipal wiring powers. These we have condemned, because they tread on what is legitimately the ground of private enterprise. We have never doubted, however, that many a householder may be more ready to adopt electricity if he

finds that easy schemes are introduced for effecting the wiring of his house, and we have seen in practice that the small steam or gas power user may become an *electric* power user the more readily because the burden of the initial cost of his installation is borne by public shoulders—for these reasons municipal wiring, or municipally *controlled* wiring, may be a great help to the electricity salesman in his work. But the objections to municipal electric trading are no weaker on this account.

Electrical Engineers and Large Gas Engines.

The three important papers read before the joint London meeting of the Iron and Steel Institute and the American Institute of Mining Engineers (of which we give an abstract on this and other pages of the present issue) dealt mainly with the subject of large gas engines in relation to iron and steel works. To electrical engineers, the subject, which is wrapped up with that of our only untapped source of energy, is of exceptional interest. The chief point upon which the consulting electrical engineer would lay emphasis was not touched upon in either the papers or the subsequent debate. We should like to know how the capital cost of a blast-furnace gas power station, with producers as a stand-by, would compare with that of a steam station of equal power. Further, large gas engines have now been in operation long enough to provide some indication as to the manner in which their wear and tear compares with that of large steam engines. What, too, should be the depreciation allowance?

We are of the opinion that the large gas engine has come to stay. Thermally, its advantages are tremendous. Mechanically, we believe that the methods of washing the gas which are now in vogue will remove anxiety on this score. On the subject of the merits or demerits of two-cycle *versus* four-cycle engines, we have to confess to an open mind, settled convictions depending upon the questions of governing and paralleling direct coupled alternators driven by such sets.

Sooner or later a flood of papers on these subjects will inundate the I.E.E. and its Local Sections. But why should not discussion begin at once? There is surely enough subject matter for at least one really good paper during the coming session.

The Kjellin Steel Furnace.

A very satisfactory account of the behaviour of the Kjellin electric steel furnace was given in a paper presented by Mr. E. C. Ibbotson to the recent meeting of the Iron and Steel Institute. It appears that a fixed furnace giving a long ton of metal per charge has been at work at Gysinge, in Sweden, during the past year, and has produced 950 tons of tool steel and special steel ingots. The tool steel was chiefly made from charges containing about 80 per cent. of white pig, and 20 per cent. of steel scrap, the metal being obtained in all the usual tempers with carbon contents regulated by the addition of briquettes. When briquettes were used, the energy consumed was 1,128 kw. per ton, without briquettes 886 per ton, including all losses. The magnesite lining of the furnace lasted seven weeks without briquettes, and five weeks with them. Favourable reports have been received where the steel has been used, more particularly in connection with steels prepared for stamping dies, punches, cold chisels, screwing dies, cutlery, drills, and turning tools. Special steels of different types have also been employed with satisfaction, especially a high-speed tool steel when tested to one of the latest Government specifications. A 25 per cent. unannealed 2-in. nickel steel bar, ½ in. in diameter, gave an ultimate strength of 50·44 tons, a yield point of 30·68 tons per square inch, an elongation of 44 per cent., and a reduction in area of 60 per cent. Some electrical tests of No. 6 gauge rod showed the metal to have a resistivity of 36 microhms, and No. 16 wire one of 33·5 microhms. A tipping furnace has lately been constructed.

THE PRESENT POSITION OF THE LARGE GAS ENGINE.

There could hardly be a more impressive testimony to the industrial importance of the large gas engine than the fact that at the recent meetings of the Iron and Steel Institute and their *confrères*, the American Institute of Mining Engineers in London, papers on the subject were presented by no fewer than three authors, English, German and Belgian respectively.

Giving first place to the bulkiest of these, that by Herr K. Reinhardt, of Dortmund, which, without any discussion, will cover 107 pages of the *Journal* of the Iron and Steel Institute (in addition to 15 special folded diagrams), we propose to notice certain of its most important features, particularly as bearing upon electrical questions. The paper, of course, commences in an historical and retrospective vein. Unless much attenion is given to Mr. B. H. Thwaite's early work—and none is given by Herr Reinhardt, not even the mention of the name of this pioneer—this development can hardly be said to have a history; all that is possible is an index of installations and a bibliography of papers.

We must give unstinted praise, however, to the exhaustive series of questions which the author drafted and had circulated by means of the Society of German Ironmasters. These are of a most searching character, and cover size, type, cooling and purifying of gases (both method and cost), the stoppages and troubles occurring (together with the causes of these troubles), amount of cooling water, amount and cost of lubricants, and the most suitable sizes for blowing engines and for driving dynamos, and a question as to whether alternating-current generators run satisfactorily in parallel.

Selecting points of chief interest from the replies, we would note that the author records the fact that of the 49 German smelting works questioned, 32 had already gas engines at work, and nine had such engines on order. In actual operation on March 1st there were 203 engines having a total effective horse-power aggregating 184,000. In course of erection, or on order, there were 146 engines aggregating 201,000 h.p. Of a combined total of 385,000 h.p., 64 engines were of the single-acting four-cycle pattern, accounting for 34,000 h.p.; 88 were of the single-acting two-cycle pattern, amounting to 81,000 h.p., and 197 were double-acting four-cycle motors amounting to 260,000 h.p. In order that the tally may be as nearly up to date as possible, the author notes that there has been ordered between March 1st and July 1st of the current year 31 engines aggregating 36,150 h.p.; 14 of these are to be used for driving blowing engines, seven being two-cycle engines, and seven double-acting four-cycle motors, the respective aggregate powers being 7,800 and 9,400. For driving dynamos, 17 double-acting four-cycle engines were on order, these aggregating 18,950 h.p. Before we leave these statistics, we may note that, taking present installations and present orders, there will be at work 161,300 h.p. for blowing purposes, 16,100 h.p. for driving rolling-mills, and 206,100 h.p. for driving dynamos. Of the 199 engines falling under the latter category, 48 are single-acting four-cycle motors, 41 are two-cycle motors, and 110 double-acting four-cycle motors. The largest aggregate installation at any single works is of 35,000 effective horse-power; 16 works possess over 10,000 h.p., and 27 works over 5,000 h.p., all in actual working. In most of the ironworks the gas engines work continuously without any reserve engine power; a few have up to 40 per cent. reserve of gas engines, and a few have a similar reserve of older types of steam engines and steam turbines. Nearly all the engines in ironworks use blast-furnace gas. Two plants use only coke-oven gases, three use blast-furnace gas and coke-oven gas separately, and one plant uses the two gases mixed. The Mansfeld Co. utilises the waste gases from the copper smelting furnaces for driving gas engines. Producers employing coke as fuel are kept as a reserve at seven works; these are for use only in case of a strike, to assure the working of the most necessary part of the plant.

As to the practical experience obtained in working, considerable space is given to dust and the various washing devices for its elimination. In the amount of trouble which it occasions, this varies with the type of engine and methods

of purification in vogue. The adjustment of the latter is apparently a matter of great nicety, as the percentage of moisture in the washed gas affects engine working and economy. As regards cleaning of the engine, when the gas is well cleaned and contains from 0·015 to 0·03 gramme of dust per cubic metre, and at the same time well cooled and dried, the inlet gear must be cleaned at intervals of two or three months, and a complete and internal cleaning must be undertaken every six or eight months. In a few plants using gas which is specially clean, the engines require less frequent cleaning. In others the inlet gear, throttle valves and other similar parts require cleaning at periods of 14 days. At the same time, when the lubrication is not excessive, and even when the gas is not well cleaned, an internal cleaning of the engine every two to three months is sufficient. The parts before the cylinder require for cleaning on an average from six to 20 hours, according to the size and build of the engine and the number of men employed, and the internal cleaning requires from two to eight days.

The quantity of water used for cooling the cylinders and pistons averages 8·8 to 11 gallons per hour and per effective horse-power. The consumption of gas has not yet been sufficiently tested to compare the various systems.

According to trials made at ironworks, the heat employed by the engines varies from 2,200 to 3,300 calories per hour and per effective horse-power. Most ironworks are at present not yet in a position to determine the consumption of gas in their engines, and content themselves with testing the exhaust gases, and thereby determining the completeness of the combustion in the motor.

From the answers received from the ironworks and collieries to the question, it may further be concluded that the old arrangement of the single-acting four-cycle motor, with one or more cylinders, has no longer in recent years been generally used, and that, on the other hand, double-acting four-cycle motors, mostly with tandem cylinders, are in keen competition with two-cycle motors. There is, therefore, little necessity to deal in this paper with the obsolete single-acting four-cycle motors, which have been replaced by newer designs, particularly as many of these engines were only considered by their designers as of temporary construction, owing to the heavy demand which suddenly arose for large gas engines.

The author then proceeds to examine the whole question of gas engine design, commenting on various types of cylinders, valves, valve gear, governing, stuffing boxes, ignition and starting devices. In regard to ignition, the author points out the difficulties arising when the sparking plugs become covered with moisture on standing. Another source of trouble is mentioned in the following manner :—

"Should ignition fail at one end of the cylinder while the engine is working, this requires the driver's special attention. This failure may be occasioned by a leakage of the cooling water from the piston, at a pressure of 3 to 5 atmospheres, by the partial fracture of the piston, of the walls of the cylinder, or of the cover. This water, leaking out during the suction period, squirts against the plugs on the return stroke of the piston.

"In such cases, when the driver is convinced that the outer ignition apparatus is in good order, the engine must be stopped and the reason of the ignition failure ascertained: also, if the load on the engine will allow of its being done, one end or one cylinder should be put out of service. If, however, it cannot be spared, at any rate the gas in the cylinder concerned must be shut off, and the compression working cut out, for instance, by wedging up the exhaust valve. If it is supposed that the piston is cracked, even though the leakage be very slight, the cylinder should only be kept at work in case of great necessity, because the presence of water in the cylinder quickly causes considerable wear. If the above-mentioned precautions are taken, namely, to heat the ignition plugs before starting, and, moreover, to make sure that the gas is suitable and burning with a steady bluish flame, the starting of gas engines no longer offers the slightest difficulty. Further, since the general adoption of compressed air for starting large gas engines, the time has passed when hours, and even days, were spent in vain efforts to make the engine start.

"The pressure of the air employed ranges from 6 to 25 atmospheres. In most cases the valves work in the same cycle when starting as when running. The compressed air is admitted at what would usually be the commencement of the combustion stroke and gives the engine a start. The moment of admission of the compressed air should be determined in consideration of the fact, in case of an ignition of the gases now drawn in, the combustion pressure attained is higher than that of the compressed air. Further, no such admission should take place before or during combustion, as it would deteriorate the mixture. In multiple cylinder engines, particularly two-cycle engines, which can start with a corresponding small load, starting is often possible by admitting compressed air to one cylinder. In such cases ignition must be allowed to take place in the second cylinder, then the compressed air must be shut off in the first cylinder and then after a few revolutions, and after the moisture originating from the compressed air has been evaporated by the heat developed by compression, the gas valve in the first cylinder must also be opened. In starting gas engines the ignition mechanism must be so arranged that ignition of the mixture takes place at a time which corresponds to a smaller crank angle, distant from the dead centre than obtains at the regular speed. In the same manner the ignition must also be regulated by hand if the number of revolutions of the engine is variable, as is the case with gas-blowers."

The author then proceeds to discuss various types, and to describe their salient features, these including the double-acting four-cycle engines of Maschinenbau-Gesellschaft Nurnberg, together with similar engines by Ehrhardt and Sehmer, of Schleifmühle; by the Markische Maschinenbau Anstalt, Wetter-Ruhr; by the Elsassische Maschinenbau Gesellschaft, Mulhauser; by the Fried. Krupp Aktien Gesellschaft, Essen-Ruhr; by the Gutehoffnungshutte, Oberhausen; by the Maschinenbau-Aktien Gesellschaft (formerly Bechem & Keetman, Dursburg); and by the Dingler'sche Maschinenfabrik A.G., Zweibrucken. The only two-cycle engines to be taken into consideration are the Oechelhäuser and Körting systems.

The first is represented by the engines constructed by the Ascherslebener Maschinenbau-Akt. Ges. and by A. Borsig, Berlin, the latter engines by Körting Brothers themselves and their concessionaires, who are Gutehoffnungshutte, Oberhausen, Donnersmarckhutte, Zabrze, Siegener Maschinenbau-Aktiengesellschaft, and Maschinenbau-Aktiengesellschaft, formerly Klein Brothers, Dahlbruch.

Most of the ironworks answered the author's question as to the most practical size of the engines, viz., for driving dynamos, 1,000 to 1,200 B.H.P. per unit; for driving blowing cylinders for each blast furnace, a separate engine, usually, say, from 1,000 to 1,200 B.H.P., or in some cases, larger units, say, from 1,600 to 3,600 B.H.P., according to the efficiency of the furnace. Concerning the size of the engines, it may be observed that with a few large units, as compared with a larger number of smaller units, the reserve power of the plant, also the safety of the apparatus, for example, of the pistons and cylinder covers, diminishes; and, further, that the cleaning of the large engines is more complicated and takes more time.

Units larger than 1,000 to 1,200 effective horse-power are only to be found in very large plants, or where the space is limited.

"From the answers received to his last question concerning the possibility of connecting alternating-current dynamos in parallel, when driven by gas engines, this, stated generally, can be done without special difficulty. From several sources it is gathered that sometimes the practice of switching in at the moment that the engine is running without load occasions difficulty; that naturally depends not only upon the degree of uniformity of the engine, on the momentum of oscillation of fly-wheel, and on the construction of the dynamo, but, above all, upon the action of the governor and the formation of the mixture at the time named, and for this reason will vary with the design of valve-gear."

After considering all these various types, the question as to which system—two-cycle or double-acting four-cycle—should be adopted, the author makes the following statement :—

When the double-acting two-cycle engine was introduced by Körting Bros. in the year 1902, a number of engines made by them met with general success; this engine, as compared with the then existing single-acting four-cycle

engines, showed such marked progress in this line that many considered that the four-cycle system was no longer a serious competitor. The builders of the four-cycle motors were, however, guided by the success of the Körting engines in the right direction, namely, of reconstructing their engines as double-acting engines with a single closed cylinder, and to arrange two of these cylinders, the one behind the other, with the object of increasing the mechanical duty. Prof. Meyer had already at that time called attention to the fact that, in view of the large negative work expended in the charging pump of the Körting engines, the double-acting tandem four-cycle engine would, without doubt, again seriously compete with the Körting engine. That this forecast was a correct one may be seen from the statistics given at the commencement of this paper.

Many persons at the present time, in judging the question of system, go so far as to prophesy that the gas engine will return to its original starting point, viz., the four-cycle system, while others, equally convinced, affirm that the four-cycle will not continue to be adopted by ironworks and other manufactories. Even with the experience gained up to the present time, it is impossible to give an opinion, based upon sufficiently trustworthy evidence, in favour of either of these opposing views. It is impossible to come to a conclusion from the total horse-power, for up to March of this year engines with 260,000 B.H.P. were at work, or on order, for double-acting four-cycle, as against 91,000 for two-cycle, without further considering the proportionate value of the two systems. If these figures prove that the competition of the two-cycle engine must not be neglected, on the other hand, the importance and connection of the builders of the four-cycle types must be considered advantageous to the latter.

The builders of two-cycle engines themselves admit that these motors are less adapted for the high speeds required for driving dynamos than for driving blowing engines and pumps, because, with a reduced time of charging, the resistance of the charging pump cannot be kept low enough, and principally, owing to the relatively large number of explosions (especially with gases of high calorific value, such as coke-oven gas), the flow of heat through the metal walls, the lessened security of the explosion chamber against breakage, and the occurrence of premature ignitions, create uncertainty; moreover, the governing hitherto employed in two-cycle engines for dynamo driving is, as a rule, inferior to that of the four-cycle engines. For this reason it may be explained that several firms who build two-cycle engines have lately decided to adopt also the manufacture of double-acting four-cycle engines.

On the other hand, the two-cycle engine is, without any doubt, most suitable for driving blowing cylinders; for, as already stated, it permits, within wide limits, a variation in the number of revolutions per minute; it starts easily against a load, and at the slow speeds of the blowing piston the work of the charging pump is not excessive. Klein Bros., for instance, state that the work of their charging pump with valves is from 6 to 7 per cent. of the work of the power cylinder, so that the difference, compared with the negative work of the four-cycle motor, no longer preponderates.

Theoretical discussions concerning the correct or the incorrect mechanical efficiency, which during last year created such a stir in Germany, can for the present contribute nothing to elucidate the question of the systems. For the managers of works, in addition to inquiring about the price and power of a gas engine, above all inquire about the security in working, and least of all about the quantity of gas consumed per brake-horse-power. They do not trouble themselves at all about the mechanical efficiency.

Suitable trials concerning the consumption of gas in more recent engines are not available for comparison, therefore it is not known how far the two-cycle engine is at the present time, in this respect, still inferior to the four-cycle engine. Should the ironworks now be compelled to consider an economy of gas, the author does not believe that the larger consumption of the two-cycle engines would for long have any great influence on the question of systems; for then the ironworks would probably first consider a more thorough cleaning of the gas employed for heating the blast and for burning under the boilers, thereby increasing its value, and in this manner save gas. So long as these conditions remain as they are, and so long as the four-cycle engine is not more secure under average working conditions than the two-cycle engine, so long will the question of systems not be decided by general and theoretical considerations, but in such cases by the ironworks and mining industries themselves.

The situation was well summed up by a manager who, referring to this very point, told the author personally that he himself preferred double-acting four-cycle, but his engine drivers preferred double-acting two-cycle.

In conclusion, the author stated that the present position of the application of gas engines in German ironworks shows the value the managers of these undertakings attribute to the better and less dangerous utilisation of the waste gases of their furnaces, and the successful efforts that have been made by the German engineers in order to meet the requirements suddenly demanded by ironworks. It also proves that German ironworks are obliged to utilise to the uttermost the sources of power at their disposal, in order to ensure their existence and their participation in the trade of the markets of the world. In other richer countries, with more favourable conditions, the matter is not so urgent.

Passing next to Prof. H. Hubert's paper, we would note that the author stated that "the idea of directly employing it (blast furnace gas) in gas engines . . . . occurred simultaneously to several engineers." Against this version of history, Mr. B. H. Thwaite energetically protested as the last speaker in the discussion. Prof. Hubert described in detail the history of the development of blast furnace gas engines in Belgium, and pointed with natural pride to the fact that the prophecy of Messrs. Bailly and Kraft, of the Cockerill Co., published in the *Annales des Mines de Belgique* to the effect that for each 100 tons of pig produced per day in the blast furnace, 3,000 H.P. would be continuously available, had been more than justified in actual working.

Excluding engine details, upon which we cannot touch in this abstract without injustice to other manufacturers, the cream of Prof. Hubert's paper is given in the two tables on p. 166, of which Table I deals with the detailed tests on a 1,400-H.P. two-cylinder double-acting tandem Cockerill engine.

A succeeding Table, which we also reproduce on p. 166, shows the advances made between 1896 and 1906 :—

These figures are significant. In comparing the trials of 1906 with those of 1900, which gave results which were considered excellent at that time, there was found a diminution of 15 per cent. of calories used per I.H.P. For the brake-horse-power the reduction attains 31·4 per cent. Finally, the thermal efficiency has been increased 18·4 per cent. The advance made is thus very considerable. The advantage obtained, as compared with the employment of steam, is by no means the least interesting of facts brought out by this investigation. Admitting, however, that a 70 per cent. efficiency is obtained by burning the gas under boilers, which is considered satisfactory, and that the steam raised amounts, according to Carnot's cycle, to an efficiency of 40 per cent. (between 200° and 10°, which the cycle of Rankine makes 77 per cent. of that of Carnot), and finally that one could succeed in obtaining 80 per cent. of the Rankine cycle, the thermal efficiency becomes :—

$$0{\cdot}70 \times 0{\cdot}40 \times 0{\cdot}77 \times 0{\cdot}8 \times 100 = 17{\cdot}25,$$

which is lower by 42 per cent. than that of the motor above described.

It has been assumed earlier in the paper that a blast furnace producing 100 tons of pig-iron per day produces about 9,000 cb. metres of gas at 1,000 calories available for the production of power.

Under these conditions, by obtaining 2,450 H.P. with the steam engine and 4,220 by using the gas direct in gas engines, there remains a difference of 1,770 H.P. in favour of this new application over the results obtained by a first-class steam plant of the usual (boiler) type.

Lists were also given of various Cockerill gas engines supplied from the Cockerill works, and from the works of their licensees.

Table I.

Description of test.	Indicated horse-power.	Brake horse-power.	Electrical horse-power.	Mechanical efficiency, per cent.	Electrical efficiency, per cent.	Total efficiency, per cent.	Consumption per H.P.-hour in cb. m., at 760 mm. per sq. cm.			Highest calorific power by Witz bomb, per 3 m. Calories.*	Calories used per hour and per			Thermal efficiency, per cent.	Heat carried away by water of circulation, per cent.
							I.H.P.	B.H.P.	E.H.P.		I.H.P.	B.H.P.	E.H.P.		
½ load ...	1250·48	986·00	917·5	78·7	93·1	73·3	2 513	3·187	3·425	979	2460·2	3120·1	3353·1	29·82	16
¾ load ...	1463·88	1333·2	1250·7	91·10	93·8	85·4	2·313	2·540	2·707	963	2227·4	2446·0	2606·8	28·52	16·2
Full load	1569·45	1466·15	1377·45	93·41	93·9	87·76	2·247	2·406	2·560	983	2208·8	2365·1	2516·5	28·77	20·2
Full load	1607·74	1494·8	1404·7	92·97	94·0	87·4	2·325	2·497	2·657	943	2192·5	2254·7	2505 6	28 98	
Overload	1755·06	1581·9	1487·7	90·00	94·0	84·7	2·155	2·352	2·542	988	2129·1	2363·3	2511·5	29·84	20·2

*This is greater than that given by the Junkers calorimeter.

Table II.

No.	Description.	Date of trials.	Power.		Consumption of gas.		Consumption of heat.		Thermal efficiency, per cent.
			I.H.P.	B.H.P.	I.H.P.	B.H.P.	I.H.P.	B.H.P.	
1.	8-H.P. engine	1896	5·26	4	4·03	5·30	4030	5300	15·77
2.	200-H.P. engine. Single cylinder, single acting, constant admission	July 19th-20th, 1898	213·9	181·82	2·830	3·329	2775	3625	22·9
3.	600-H.P. engine. Single cylinder, single acting, constant admission	March 20th, 1900	825·8	670·0	2·560	3·156	2520	3106	25·2
4.	200-H.P. engine. Single cylinder, single acting, variable admission	December 2nd, 1901	246 9	215 3	2·981	3·418	2766	3172	23·0
5.	1,400-H.P. engine. Double acting, tandem, variable admission	Jan. 9th and 10th, 1906	1755·06	1581 9	2·155	2·392	2129	2363	29·84

The third paper, by Mr. Tom Westgarth, entitled "Notes on Large Gas Engines Built in Great Britain, and upon Gas Cleaning," was very brief. On its statistical side it is to be commended by reason of the fact that a separate table is given to each make of engine, its cylinder arrangement and duty described, together with the nature of the fuel (blast furnace, producer or coke-oven gas) used. In the following table, condensed from Mr. Westgarth's, only large gas engines, *i.e.*, those of over 500 H.P., are included, as smaller engines have not been enumerated by him.

Gas Engine Installations in the United Kingdom.

Type.	Builder.	No. of installation.	No. of engines.	Aggregate I.H.P.
Oechelhäuser	Wm. Beardmore & Co	9	28	32,600
Körting ...	Mather & Platt ...	4	6	4,875
Premier ...	Premier Gas Engine Co.	9	28	16,950
Willans & Robinson	Willans & Robinson	1	2	1,800
Crossley ...	Crossley Bros. ...	16	31	19,360
Cockerill ...	Richardsons, Westgarth & Co.	9	24	20,500
	Total ...	48	119	96,085

Mr. Westgarth notes that most engineers commence cleaning the gas for engines by passing it through ordinary fans of water. It was soon found that two or more fans in series would be necessary, and that a considerable quantity of water and much power was required, the result not always being satisfactory, particularly if the gas had not previously been very well cleaned and cooled by passing through large dust-catchers and long mains. A difficulty also occurs with the moisture absorbed by the gas in the fans, and it has been found necessary to supplement the fans by various cleaning and drying devices. Illustrations are given in the paper of various methods of cleaning.

Of the contributions to the discussion we would only note that of a member of the American Institute of Mining Engineers, who naively explained the backwardness of his country by an electrical parallel. In the early days of electrical transportation, those who had been the first to discard mules had been heavy losers, as in five years their plant had become obsolete. Those who had waited until others gained experience then came in and made money. So in regard to large gas engines. Hitherto they had hung back to see how things were going, and let others experiment. Now they had secured licences and were going right ahead.

As a confession of a hitherto undiscovered tendency towards caution and conservatism in American engineering progress, such remarks are novel, unexpected and almost historic!

CORRESPONDENCE.

***Letters received** by us **after** 5 p.m. on Tuesday **cannot appear until the following week.** Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Resinous Matter in Para Rubber.

I should like to draw your attention to a statement made in Mr. John Langan's paper on "Standardising Rubber-covered Wires and Cables," published in the *Proceedings* of the American Institute of Electrical Engineers, Vol. XXV, No. 4, April, 1906, which I think needs some modification. In referring to the amount of resinous matter contained in fine Para rubber, Mr. Langan states that it seldom exceeds 1 per cent. Now, as a rubber chemist of many years' experience, and from the results of scores of analyses, I beg to say that no sample of Para rubber has yet come under my notice with so low a percentage of resinous matter. As a matter of fact, the amount of resinous matter contained in pure Para rubber, washed and dried as it would be used in the manufacture of rubber-insulated wires, varies from 2 per cent. to as much as 5 per cent.

I should be obliged by your inserting the above note in your esteemed journal at an early opportunity, as Mr. Langan's figure may be misleading to consulting engineers and electricians who have to draw up specifications.

W. F. Eichenauer, F.C.S.

Woolwich,
July 26th, 1906.

Manufacturers Selling Direct to Consumers.

The suggestion of "One of the Pinched" to start a "black list," is a good one, and one that would tell very severely on the manufacturers so transgressing if all contractors could be induced to band together. In the meantime, a great deal of good could be done by the E.C.A. if they would start it (with a committee to consider each case fairly) and distribute the list amongst all contractors.

In our own town we find that an electrical company has supplied a large drapery establishment throughout with Nernst lamps, and one of their representatives calls regularly

to take orders for burners, although he does not call on the electrical firms in the district.

We shall be glad to hear of a movement to stop such proceedings.

pp. **The Northern Electrical Co.,**
J. P. C.

Doncaster, *July 30th*, 1906.

The discussion to which you have opened your columns is one of much greater import than appears at first sight.

We hear any amount about "free trade," yet forsooth what is equivalent to a duty of 25 per cent. to 40 per cent. is paid to middlemen in all sorts of trades, who in the world's work only act the part of distributor. If these middlemen act as manufacturers' agents a sales commission is undoubtedly due to them, but can any industry fairly stand the so-called "trade discounts" now given? Anything that tends to cheapen the article to the consumer tends to increased sales, and therefore the fewer the hands through which articles pass between manufacturer and user the better for both parties and trade generally.

The example of the cycle trade given by "Cables" is a very good one. While the cycle boom lasted prices were high enough to allow profits both to the manufacturer and large trade discounts to the agent as well, but when the slump came and artificial prices had to fall, manufacturers very wisely cut down their discounts to a reasonable selling commission. The only pity is that other classes of manufacturers do not follow their example. The incompetence of the average "cycle agent and repairer" of a few years ago was largely due to the 50 or 60 per cent. discount he received. Possibly the jerry wireman is also a product of trade discounts.

Consumer.

A Bucking Motor.

Can you or any reader kindly explain the following:—A 1½-H.P. direct current motor supplied with current from a London company's mains, and controlled by D.P. switches and starter with no-volt release, after working for some time suddenly reversed direction of rotation, damaging some work. It was stopped for a day and tried again, when exactly the same thing occurred. On its being tested the reading was rather low, but otherwise everything appeared satisfactory, and the motor started away again all right. A lamp placed between the company's mains and earth was found to light up to about three-quarters normal candle-power from both positive and negative wires.

Wireman.

Alternating-Current Instruments.

The article on alternating-current instruments in your last week's issue contains an appreciative description, together with a fair and scientific criticism of some new instruments of mine. But you make one statement which I cannot allow to pass unchallenged. You say, "We understand that the scheme of the instruments is not Dr. Sumpner's, having been used by other designers before."

Of course, there is nothing new nowadays in the mere use of an electro-magnet, or in that of a moving coil or other such accessory device, but it is undoubtedly quite new to use the following combination:—(1) A specially-designed shunt magnet excited by the voltage of the circuit; (2) a coil of wire free to move in the field of the shunt magnet, and supplied with current due, not to the inductive action of the shunt magnet, but to (3) a specially designed accessory, such as I have described.

The reasons for using such a combination, and the conditions necessary to ensure accuracy in an instrument when constructed on these lines, will be found, as you state, in the theoretical and experimental papers I have written, and which I need not refer to further now. But I must point out that electro-magnets as used hitherto in instruments have nearly always been series excited, that is to say, excited either by passing the main current through the coils, or by connecting these coils across the mains through a large non-inductive resistance. In either case the magnetising current is made proportional to, and in phase with, the quantity (current or voltage) to be measured, and it is invariably assumed that the magnetism produced follows the variations of the magnetising current with sufficient accuracy. This assumption is, in my opinion, rarely, if ever, justifiable. On the other hand, although shunt magnets have sometimes been used for instruments, the great advantage obtainable from their use has not, I consider, been previously realised in practice. When a suitably designed shunt magnet is put across the mains, its magnetism is directly controlled by the alternating voltage of these mains in accordance with a mathematical law which at first sight does not appear at all hopeful for instrument purposes, but which, as a matter of fact, can be shown to be a convenient law having a most important property—viz., entire independence of the properties of the iron, so that variations in permeability and hysteresis do not affect the relationship between the magnetism and the exciting voltage. The only instruments in which shunt magnets having low-resistance windings have been used are those of the induction type. In these instruments the special feature of the shunt magnet is not taken advantage of. The iron is used as the core of a transformer rather than as an electro-magnet; the currents in the moving system are not kept in definite paths as in a moving-coil instrument; and these currents are mainly due to the inductive action of the magnet itself. Both in action and in principle my instruments are quite distinct from those of the induction type, and they are also entirely different from instruments of the series magnet type such as that devised by Dr. Drysdale.

The "severe" criticisms of Mr. Franklin Stevens in the *Electrical Review* of New York cannot be taken seriously, since they are founded on a misunderstanding of the instruments. I have found his criticisms much more amusing than alarming, and they are directed not so much against me as against the British nation in general. But in spite of all this terrible curse, no one appears a penny the worse!

W. E. Sumpner.

Tunbridge Wells, *July 30th*, 1906.

[If we have unintentionally done less than justice to Dr. Sumpner, we willingly express our regret.—Eds. E.R.]

Rapid Methods for Producing Electrotypes.

The gratitude of electrotypers of all grades is due to Mr. Cowper-Coles for his masterly paper on "Rapid Methods" in electrotyping, which ought to go far towards revolutionising the industry.

Electrotypers are, as a class, a cold-blooded crew, and far from effusive in their methods of expressing their thanks. This is proved by the fact that five or six weeks have elapsed since the first instalment was published, and not a single word of comment or dissent has yet appeared.

Of course, "Fools rush in where angels fear to tread," but the fear of being classed with the fools should not be allowed to prevent the humbler disciples from attempting to discuss with the Evangelist of a new school points of interest in so important a branch (though apparently not yet fully recognised as such) of the electro-chemical industry as electrotyping.

As a young beginner in the art I feel particularly indebted to Mr. Cowper-Coles for having thrown a little light on the methods by which my more successful rivals are enabled to get—and get through—more than their fair share of work, but I must admit that there appears in Mr. Cowper-Coles's paper to be too large a percentage of history and prophecy and too little practical detail, while some of the illustrations are far from clear.

This is not surprising, as the same defect is noticeable in most available works on electrotyping, but possibly the gifted author will oblige, when his attention is drawn to the points likely to fog a beginner, by condescending to give a little more information.

Therefore, to begin, on page 949, fig. 3 is stated to have electrodes in series, and so—presumably—has fig. 1, but the reader is left to decide for himself whether or not the vats are sub-divided into separate cells.

Again, fig. 4 shows that 12 per cent. (by weight or measure is not stated) of sulphuric acid gives a solution which offers a trifling resistance either hot or cold. The

practical advantage of increasing the acidity above this point and heating the bath so as to utilise its superiority in conductivity over a cold bath is not shown—at any rate, not shown in such a way as to convert a battery hand who has had his clothes rotted by highly-acidulated liquor, not to mention the extra labour in getting rid of the excess of copper sulphate formed.

There is something quite wrong about the data on p. 949, and also the calculations. A shell ·025 or ·03 in. thick would at 10 amperes per sq. ft. take 40 or 50 hours to grow, not 12 or 15, but no sane person would think of habitually making shells this weight.

There is a much simpler, better and cheaper form of looped hook than that shown in fig. 5, and the elaborate fake shown in fig. 6 is sheer waste of money.

Fig. 7 shows connectors for suspension rods, but the author does not state whether they are for the series or parallel electrodes. In either case they must prove a heavy addition to the cost, especially if modified to enable them to carry the heavy currents required for rapid methods, and if for rods in parallel, the waste of jointing material must be ruinous.

Fig. 8 unmistakably refers to Starrett's Patent No. 14,823 of 1903, and fig. 9 is evidently Haas's old Patent No. 7,358 of 1896.

A good deal is said about the resistance of the electrolyte depending on its composition and its temperature, but no reference is made—and all the text-books agree on this point—to the fact that the *spacing* of the electrodes is the most important factor (incidentally enabling the electrotyper to dispense with rheostats), which is varied (for better or for worse, according to the point of view) by the introduction of anodes of fancy shape or fantastic construction.

I am not, of course, presumptuous enough to attempt to correct Mr. Cowper-Coles. I merely point out these errors and omissions so that they may not mislead the young and inexperienced, and by so doing diminish the usefulness of his admirable paper.

Nemo.

Wiring with Flexible.

The initial cost of installing electric lamps is admitted to be one of the chief drawbacks to the advancement of electric lighting, more especially in small towns where the consumers are still more reluctant to incur any small outlay required to keep the wiring in fair order. This renders it essential that the wiring must be, in the first instance, erected in a solid manner to last for years. In a country town in which the writer is interested, there is an undue amount of flexible used, which gives no end of trouble.

If manufacturers slotted out base blocks for ceiling roses and switches to take 1½-in. casing, it would help towards economy.

As so much time and money is constantly being spent in installing electric light, perhaps, without creating a precedent, the Editor may consider it within the scope of the Electrical Review to invite contributions and suggestions on the best ways and means of reducing the initial cost of installing electric light, and to offer suitable remuneration for the same. Until this is accomplished the inhabitants of small towns will have to continue to enjoy a blind man's holiday.

Manager.

[We are loath to surmise that our correspondent has a "contribution or suggestion" up his sleeve, awaiting the offer of suitable remuneration! We are, of course, always ready to consider contributions submitted for that purpose, to publish them if suitable and if space allows, and to remunerate the author, or, in brief, "to pay" for them. Deliberately to invite contributions on this very contentious subject would, however, probably result in a flood of MSS., the bulk of which we could not possibly use, and consequently in much disappointment to the authors.—Eds. E.R.]

The Penetrating Properties of the Arc Light.

Several statements *re* light penetration have appeared recently in the "Correspondence" columns of the electrical Press, the accuracy of which I seriously question.

In the *Electrician*, of July 20th, 1906, M. Laporte writes :—"It is generally agreed that the air in the neighbourhood of the earth is more transparent for yellow and red radiation than for radiations of shorter wave length."

And again, in the Electrical Review, of July 27th, 1906, the following statement occurs in a letter from the Kitson Light Foreign Supply Co. :—"Any lighting engineer knows . . . . that the blue rays which preponderate in the electric arc will not penetrate the fog for any distance, whilst the red and yellow rays do, and as the Kitson system is rich in these, it stands to reason that it should be a better illuminant during fogs than the electric arc. The same is true of the oil-wick lamp and an ordinary gas jet."

I do not question the statement, that an oil-wick lamp will penetrate fog better than the light from a carbon arc, but I question the accuracy of the explanation, which is generally accepted as the true one.

I maintain that the difference in the penetrating properties of the two lights is entirely due to the difference in what is usually termed their intrinsic brilliancy, but which I prefer to term the difference in the light density of the two illuminants.

I think it will be found that if the two sources of different coloured illumination have the same flux of light per square centimetre of radiating surface, then the illuminant rich in blue light will penetrate the atmosphere somewhat better than the illuminant rich in red and yellow light.

If I am not correct in stating that blue light penetrates the atmosphere better than any other colour, perhaps the manager of the Kitson Light Foreign Supply Co. will kindly explain to me and others through your columns, why it is that distant objects appear blue.

C. Orme Bastian.

London, N.W., *July 30th*, 1906.

Inaccurate Electricity Meters.

I was greatly amused to read Mr. Hornby's letter in your last issue, in which he states that he would alter the Board of Trade regulations on the above subject, presumably to give his meters a better chance of complying with them.

Whatever limit is adopted, a meter ½ per cent. more inaccurate will, of course, be officially "incorrect," and it is more "absurd" to reject a meter of ½ per cent. outside at a 6 per cent. limit than it is at 2½ per cent., because the per cent. difference in error is much less, so that the "real advantage" he speaks of is non-existent. Furthermore, I do not see any absurdity in rejecting a meter that is 3 per cent. wrong. Surely electricity, of all forms of energy, is most easily accurately measured, and, in my opinion, this limit is quite high enough. As to his last paragraph, the natural inference is that, as he wants the limit raised, his "modern meter" is rather uncertain in its permanence of adjustment. But from experience of five or six thousand meters of various types I am convinced that there *are* meters on the market that *do* run for, say, five years in the consumer's coal cellar and come out still within the B. of T. limits. At the end of that time, it is only reasonable to overhaul them, whether the test is good or bad; but the great majority of the meters of a certain type do conform with the above conditions.

E. Fawssett.

Newcastle-on-Tyne, *July 30th*, 1906.

The dispute about inaccurate meters between the consumer and the supply station will still go on as long as the legal limit is as narrow as it is at present, and we quite agree with Mr. Hornby that the limit should be raised to, say, 6 per cent. on consumers' premises and 4 per cent. in the testing station between one-tenth and full load.

If narrow limits are fixed unreasonably there will always be a large percentage of inaccuracy in the meters, because these limits are taken from sample instruments which are giving excellent results in the laboratory of the authorities, but are fixed without consulting the manufacturers, who know best what accuracy they can obtain from their meters.

Of course, instruments which keep inside such limits can be made, under fair conditions, but it is quite natural that

the ordinary supply type meters do not give the best results if they are treated very roughly and carelessly; and further, if the manufacturers are pressed, as they are at present, for cheaper and still cheaper meters, which cannot be adjusted sufficiently, and, therefore, cannot give such good results as a well made meter which is paid for at its value.

As mentioned by Mr. Hornby, with wider limits the supply station can defend its meters better when disputed by unreasonable consumers, and so save the trouble of exchanging meters.

E. Dormann,
Engineer to Aron Electricity Meter, Ltd.

London, N.W., *July 31st*, 1906.

The methods of ascertaining the value of a supply of electricity, as defined by the Electric Light Acts and provisional orders generally, are open to adverse criticism. This being a matter of vital importance to all electric supply undertakings, the time has arrived for the I.E.E. to appoint a committee to inquire into the legal aspects of a supply of electricity as a commercial commodity.

A model form of consumers' agreement is required badly, and likewise a model form of specification for meters.

P. T. O.

Gas v. Electricity.

There is no doubt that jerry wiring is to blame for much of the lighting work going over to the gas people, and this, to my mind, points to the necessity of having a vigilant outside staff and a "live" man at the head of the mains department.

So long as embryo engineers are left responsible for outside work, Mr. A. J. Abraham and others can go on "issuing circulars to intending consumers" what time the wiring contractor plays havoc and flourishes.

The mains superintendent should not be the "soft-job man" so often to be found on corporation staffs; he should rather be an alert worker, a man of decision and sound judgment, knowing when to enforce and when to stretch his rules. He should be blessed with more than a superficial all-round mains experience. Such a man will not only awe the jerry contractor, but also do much to snatch work from the hands of the gasman.

It is a remarkable fact—and, I might add, an unhealthy sign—that in spite of low salaries numbers of first-class men do apply for such posts when vacant, although, thanks to the Councillors, a "muddler" is often selected.

Where the right men have been selected I have generally noticed a higher standard of wireman's work, a state of affairs as much welcomed by good contractors as by supply people and consumers.

W. Lunn.

London, W., *July 30th*, 1906.

In his letter on this subject last week, Mr. Abraham realises, as many others have done, the hopelessness of inducing the majority of consumers to renew their incandescent lamps after a reasonable period of service, although this may entail but a small expenditure compared with the electricity bill.

In America the supply companies have more or less successfully met this difficulty by offering lamp renewals free of charge to their customers, notwithstanding the trouble experienced through consumers sometimes abusing this concession by demanding new lamps on the least appearance of blackening of the bulb, a condition which is not detrimental to the efficiency of the lamp till it has attained an advanced stage.

A 16-c.p. lamp, consuming about 56 watts, will burn for 18 hours with a consumption of 1 unit.

Allowing a useful life of 800 hours per lamp, the amount of energy consumed by one lamp before being discarded will be about 44 units. Now, if English supply companies were to adopt a system of free lamp renewals, allowing one lamp per 40-50 units consumed, according to the life and efficiency of the lamp, this would prevent new lamps being claimed before the old ones had completed their useful life, and would ensure the replacement of many worn-out lamps which are at present a free advertisement for the gas companies.

E. G. Kennard.

Lee, S.E., *July 31st*, 1906.

[Apart from the question at issue—where is that 16-c.p. lamp consuming 56 watts, and lasting 800 hours? On a 200 or 240-volt circuit it would be more like 76 watts.—Eds.—E.R.]

Broken Commutator Connections.

I should like to know whether any of your readers experience a similar difficulty to my own. I have a large number of traction motors to keep in repair, and I find the wires on the armatures after from 6 to 18 months' running break off short, sometimes close to the commutator, and sometimes about an inch back, but never more than an inch.

There is no sign of over-heating, and no fault of any kind in the armature apparently to cause such a clean break.

Puzzled.

[This is a familiar old trouble, due generally to stresses imposed on the wires carrying currents by the stray field, and sometimes to relative movement between armature and commutator. It can often be cured by substituting flexible conductors for the stiff connections.—Eds. E.R.]

Hawkes v. Electrical Corporation, Ltd., and Bauer.

The attention of our client, Mr. J. Augustus Bauer, of 17, Gracechurch Street, E.C., has been called to your report of the case of Hawkes against the Electrical Corporation, Ltd., in your issue of the 27th inst. Mr. Bauer was a co-defendant of the Electrical Corporation, Ltd., in the action.

The plaintiff claimed damages against our client for fraudulent misrepresentation, and also damages against the Electrical Corporation, Ltd., which was an insolvent company which had ceased to carry on business.

After evidence had been called in support of the plaintiff's case, and before our client's case was opened, the plaintiff consented to judgment being entered in the action for our client, Mr. Bauer, upon all charges. The defendant corporation, which was absolutely insolvent and without either the means or motive for further contesting the action, then consented to judgment being entered against it.

A casual reader of your report would infer from it that a judgment had been given against Mr. Bauer for fraud, and you will appreciate our client's anxiety to point out at the earliest moment that the fact is precisely the contrary, and that on every charge which Mr. Hawkes made against Mr. Bauer, Mr. Bauer succeeded in obtaining judgment.

We ask you to insert this letter in your next issue, in order that the true facts may be known to the readers of your paper, to many of whom our client is well known.

Parker & Richardson.

London, E.C., *July 31st*, 1906.

"Wanderer."—The production of powerful static charges on leather belts driving machines is a well-known phenomenon. It is apparently due to friction between the belt and the pulleys, and probably is best observed when the belt is dry and slipping slightly, and the atmosphere dry also.—Eds. E.R.

Burglary.—Gresham Lodge, Watford, the residence of Mr. Cecil Hodges, of Cecil Hodges & Co., was entered by burglars on Tuesday afternoon last week, but happily they were disturbed, and their haul was considerably lessened in value on that account. Burglars are giving much attention to the residences of electrical men in this neighbourhood. It is only a few months since Mr. Tom Hawkins, of the Morris-Hawkins Co., suffered similarly.

LEGAL.

Great Northern Piccadilly and Brompton Railway.

Mr. Justice Walton had before him on 27th ult. a case in which the Attorney-General sought to recover certain penalties (£13,200) from the Great Northern, Piccadilly and Brompton Railway Co., under Section 113 of the Stamp Act for failure to state an increase of the nominal capital of the company. The defendant company was formed in 1902, when the Great Northern and Strand Railway project was handed over to the Brompton and Piccadilly Circus Railway Co. The transfer carried power to raise capital amounting to £2,400,000, on which the Great Northern and Strand Co. had already paid stamp duty. The contention set up on behalf of the Crown was that the duty should also be paid by the defendants as they had acquired power to raise additional capital.

Judgment was given for the defendant company, with costs.

A. E. Meadows *v.* The L. & Y. Railway Co.

At the Liverpool Assizes on Saturday (28th), before Mr. Justice Bray and a special jury, Albert Edward Meadows, of Formby, brought an action against the Lancashire and Yorkshire Railway Co., for damages for injuries sustained in the disaster at the Hall Road station on the electric railway between Liverpool and Southport, on July 27th last year. The company admitted negligence, but denied that plaintiff had suffered any injury or damage. Mr. Meadows's case was that the accident caused him to suffer from concussion of the brain, and extreme nervous prostration, and he had continued to get worse. His mind was affected, and he had lost his employment in a Liverpool firm of wine merchants, and had been obliged to make trips to the Isle of Man and to Jamaica. Defendants agreed to pay £1,250, and taxed costs.

The King *v.* Mountford (*ex parte* London United Tramways, 1901).

Judgment was given on Saturday last in this case, in which Mr. Mountford had to show cause against a rule obtained on behalf of the London United Tramways Co. calling upon Mr. Mountford to show cause why an inquisition verdict and judgment taken before the Sheriff of the County of Surrey on February 26th should not be quashed on the ground of excess of jurisdiction.

The facts of the case were these:—Mr. Mountford was a dentist who carried on his practice in Eden Street, Kingston, in a house which for many years had been associated with a dentist's practice, and he held the house under a lease for a term of years which was unexpired. The Tramway Co. under its powers gave Mr. Mountford notice to treat for a strip of land which formed part of the forecourt of the house, the strip being about 10 ft. wide × 170 ft. long, and including a portion of the garden and a portion of the stable. The object of doing that was to widen the street so that a double line of tramways might be introduced into that particular street. Mr. Mountford originally put his claim for compensation under the following heads:—He claimed compensation for the value of the land taken, and compensation for the damage done to his business during the time the works were being executed. He also claimed for the injury done to his premises and the goodwill of his business by reason of depriving the house to a certain extent of its approach, by reason of the injury to the light of the room in which Mr. Mountford carried on his practice, for injury to the stable, and further compensation for depreciation of the goodwill by reason of these matters and in consequence of the alteration of the character of the neighbourhood by the company bringing the tramways there and the running the cars there. The rule was granted upon the ground of excess of jurisdiction, the company alleging that the notice to treat being served in pursuance of their powers under the Act of Parliament, which powers authorised the street widening, no compensation could be awarded to Mr. Mountford by reason of the laying down and opening of the tramways which were authorised. The question before the Court was whether there was an excess of jurisdiction on the ground that Mr. Mountford had no right to put before the jury those considerations, and that the jury had no right to take them into account in assessing the compensation.

Mr. Justice Darling, in giving judgment, said the case raised a question of some difficulty as to the matters which a sheriff and his jury were entitled to take into consideration in awarding compensation in respect of land compulsorily taken by virtue of the Lands Clauses Consolidation Act, 1845, Sec. 63. That provision ensured that in estimating the purchase money of the land or compensation to be paid for the taking of it, regard should be had not only to the value of the land to be purchased or taken, but also to the damage, if any, to be sustained by the owner of the lands taken from the other lands of such owner, or otherwise injuriously affecting such other lands by the exercise of the powers of the Act. His Lordship, having stated the facts of the case, said that in the Sheriff's Court the jury awarded Mr. Mountford £360 in respect of the land taken by the company, and £400 in respect of the injurious affection of the remainder of Mr. Mountford's premises, including loss of goodwill in his business. That sum was arrived at by considering the injury likely to be done to Mr. Mountford's other land and to his practice by the tram company's legal use of the tramway laid by the company upon land which had never been his. Whether that was a matter entitling Mr. Mountford to compensation in that respect was the question they had to decide. That he would have been entitled to such compensation had the tramway been laid and worked upon, the very land taken from him appeared to be indisputable, and to follow from the decision of the Courts in many of the cases cited at the Bar. Yet even so, it seemed to him that a person whose land was taken and paid for at its full value and more, received some advantages over others equally inconvenienced with himself. In this case Mr. Mountford suffered no more from the running of the trams on the line in Eden Street than did his neighbour on the opposite side of the road whose house, indeed, was nearer to the tramway than was that of Mr. Mountford himself. For the taking of his land, Mr. Mountford had been paid £360, and in that sum was included damages for the diminished value of the land left to him, and also further damages for the use of that taken, owing to the passing over it near Mr. Mountford's house of the public and the ordinary traffic of the street. More than that he could not satisfy himself he was entitled to claim. He could not veto the making of the tramway along the public highway, nor the working of it, though the Attorney-General might have proceeded by information against the company had they run trams before the street was widened. He thought the rule should be made absolute.

Mr. Justice Phillimore concurred, and the rule was accordingly made absolute, with costs.

Mr. Gordon, on behalf of the claimant, elected to have the whole verdict quashed, and to have a fresh inquisition.

Order accordingly.

A Devonport Tramway Claim.

At Plymouth County Court on 26th ult., Albert Caley, typesetter, claimed £1,000 damages from the Devonport and District Tramways Co. for injuries sustained through an alleged negligently-driven car on December 23rd, 1905, knocking him down. The jury gave a verdict for the defendant company, and no costs were asked for.

Mica Insulator Co., Ltd., *v.* Bruce Peebles & Co., Ltd.

In this action (says the *Edinburgh Evening News*) plaintiffs sued defendants for interdict and damages in respect of alleged infringement of certain patents relating to electrical insulating sheets of which the pursuers aver they are the registered proprietors. In the Outer House, Lord Stormonth Darling allowed a proof, but the defenders reclaimed, and the First Division recalled the Lord Ordinary's interlocutor, holding that the pursuers' averments were lacking in specification. Amendments were made and the case remitted to the Lord Ordinary for further procedure. The pursuers have now abandoned the action, and his Lordship has pronounced an interlocutor accordingly.

Belfast Tramway Claims.

Last week Frances M'Creight, widow, sued the Corporation of Belfast for £2,000 damages for the loss of her husband, whose death was caused by an electric tramcar running into the vehicle in which he was riding on January 7th, 1906. The jury awarded £1,000.

A constable sued for damages sustained in the same accident, and the case was settled for £145, with costs.

The Mayor and Corporation of Southampton *v.* Courtenay.

In the King's Bench Division on Friday, July 27th, the case of the Mayor and Corporation of Southampton *v.* Courtenay came on for hearing before Mr. Justice Phillimore and a special jury. It was one in which plaintiffs claimed £918 damages for breach of contract.

Mr. Lowe, K.C., appeared for the plaintiff Corporation, and Mr. Hamilton, K.C., was for the defendant.

Defendant contracted to pay the plaintiff Corporation £25 per car per annum for the sole right to accept advertisements for every one of their regular running cars for five years, and, under the agreement, he was to pay quarterly in advance. The Corporation had 49 electric cars in all. Some of these ran three hours a day, some four hours, some eight hours and some more; but, according to the calculations of the borough treasurer, they averaged 64 miles a day for the whole year, and, on behalf of the plaintiff Corporation, evidence was given by the tramway managers of Newcastle and Birmingham to the effect that it was generally understood in the tramway world that a regular running car ran either for eight hours, or 60 miles a day.

His Lordship thereupon suggested that the case might come to an end, as the evidence showed that the plaintiff Corporation's cars accomplished 64 miles per day; but Mr. Hamilton intimated that he should prefer to put his case before the jury. When the Court met on Monday, however, Mr. Hamilton announced that an arrangement had been come to by which 45 out of the 49 cars were to be taken as regularly running cars, and that the same proportion would form the basis for calculation in case of an increase in the number of running cars during the currency of the contract.

Mr. Justice Phillimore said he thought that was a very proper arrangement.

The jury thereupon returned a formal verdict for the plaintiffs, and judgment was given accordingly, with interest.

Westlake v. St. Pancras Borough Council.

This case came before Mr. Justice Neville in the Chancery Division last week.

Mr. C. E. Jenkins, K.C. (with him Mr. Beaumont) in opening the plaintiffs' case, said his clients were somewhat numerous, having several interests, and by the action they sought to restrain the defendants from carrying on certain works of theirs adjacent to the property of the plaintiffs in such a way as to create a nuisance. The plaintiffs also claimed damages for past acts of the defendants. The nuisance alleged was first a nuisance caused by vibration set up by the engines used by the defendants in carrying on their business as suppliers of electricity in St. Pancras. The defendants had a large generating station opposite to the plaintiffs' premises, and the plaintiffs' case was that these engines caused a vibration to their premises of a nature which made their houses less comfortable and at times really intolerable. Plaintiffs alleged that the nuisance was something more than temporary, and the vibration caused injury to the plaintiffs' premises structurally, and affected the inhabitants thereof prejudicially. The other ground of complaint arose in connection with certain dust destructor works that the defendants had on the same site as their electric generating station. The defendants brought to these works the refuse of the parish for the purpose of destroying it. Defendants had also to get rid of clinkers used on their works, and the nuisance the plaintiffs complained of was the scattering around from the chimney shaft of a sort of grit or dust which covered the plaintiffs' premises if the wind was in that direction, and thus interfered with the health of the occupants of the premises, and also prevented them from carrying on their respective businesses as beneficially as formerly. Plaintiffs also complained of a nuisance by smell caused by the burning of the refuse, and also by a process that was called "damping down" the clinkers. That was a general view of the case. The defendants had become the undertakers in the year 1894, and they acquired their land about that time. In 1894 they started the supply of electricity in the borough, and erected on the land an engine house, and put in it five reciprocating engines, and the generating station was carried on for a considerable time with these five engines; but whether or not vibration was caused to neighbours by those engines did not matter, because an action was not brought. But in 1902 the defendants decided largely to increase their plant, and in May, 1903, they had three engines at work of from 700 to 900 H.P. each. The effect of this addition was to set up a serious nuisance by vibration. In 1904 Mr. Westlake complained about it in writing, and in November, 1903, the owners of certain houses in Great College Street, adjacent to the defendants' works, brought an action against the defendants seeking an injunction to restrain them from causing a nuisance. In that action, which was tried before Mr. Justice Joyce, the defendants denied any vibration at all, but they set up as an alternative defence that there were probably defects due to the engines not being properly balanced, and this they said they could put right. In that case, however, the injunction was granted against the defendants, but a stay of the injunction was granted on the footing that within that time the defendants would balance the engines properly, and then there would be no nuisance to anybody. The present plaintiffs were awaiting the result of that action. The defendants, having got the stay, occupied the six months in trying to improve the balancing of their engines, no doubt, but also in buying out the plaintiffs in that action, and he (counsel) rather thought they had bought up the whole of the side of Great College Street abutting on their works. The result of that was that defendants did not worry any more about the injunction, and ultimately, after complaints had been made, the present action was commenced on December 30th, 1905.

(To be continued.)

Mr. Justice Neville gave judgment in this case on Monday. His Lordship held that the plaintiffs had established their case as regarded one engine only, and granted an injunction with costs, except so far as they had been increased by the other issues as to which they had not succeeded.

PARLIAMENTARY.

Third Readings.—In the House of Lords on July 24th the Cork City Railways and Works Bill and the Lancashire Electric Power Bill passed their third reading, and on July 26th the South Wales Electrical Power Distribution Co. Bill, the Macclesfield and District Tramways Bill, and the North-West London Railway Bill passed third reading. In the House of Commons on July 27th the Folkestone, Sandgate and Hythe Tramways Bill was read a third time. In the House of Commons on July 26th the Kent Electric Power Bill was read a third time; on Tuesday last the Shropshire, Worcestershire and Staffordshire Electric Power Bill was read a third time.

Installation Contracts.—The Bradford Electrical Engineering Co. has recently booked a contract for the electric lighting, switchboards, &c., at the new brickworks of Messrs. Brooks, Ltd., Lightcliffe, Yorkshire; also the contract for the lighting of the Standard Hotel, Bradford, for which tantalum lamps will be used throughout.

BUSINESS NOTES.

Holiday Handbooks.—The latest handbooks received from the Health Resorts Development Association 2, Gray's Inn Road, E.C., relate to Guernsey and Broadstairs, they having been, as with the earlier publications noticed here, published on behalf of the local authorities of these places. The Guernsey handbook is the fullest, as well as being the best illustrated, of the series so far issued.

Electrical Exhibition at Bristol.—Mr. William Edwards, who promoted a successful exhibition at Bristol last year, is organising an electrical manufacturers' exhibition, to be held at Bristol in November and December next. We understand that it is designed to be a *bonâ-fide* electrical manufacturers' exhibition, to meet the requirements of the biggest firms, and bears no relation whatever to the many small shows which have been held and proved of no real benefit to the trade. Its object is to give manufacturers an opportunity of bringing the latest improvements in their various lines before the notice of electrical contractors and the public generally, and to demonstrate clearly the advantages of electricity for lighting, heating and motor power purposes. The Bristol Corporation Electricity Department has agreed to take part in the exhibition, and doubtless many manufacturing firms will follow its example and give their support. Early communications should be addressed to Mr. Edwards at 133, Cromwell Road, Bristol, with a view to securing positions. We learn that the entertainment side of the affair will be well looked after with a view to attracting a large number of people.

Brush Contracts.—Among the recent contracts booked by the Brush Electrical Engineering Co. are the following:—

For the Dumbarton Tramways (per Crompton & Co).—Six double-deck car-bodies.

For the Plymouth Corporation.—Six demi-cars complete with Brush trucks and motor equipments for one-man control.

For the Bolton Corporation Tramways.—Ten double-deck car-bodies with top-deck covers.

For the Bombay E.S. & T. Co.—10 double-class cars with Brush trucks and motor equipments; 10 single-class ditto; 20 additional trucks and motor equipments.

A German-Swiss Combination.—A further instance of the policy of consolidation which is proceeding on the Continent is afforded by the announcement that the Felten and Guilleaume-Lahmeyer Works Co., of Frankfort and Mulheim, have acquired practically all the shares in the Gesellschaft der Maschinenfabriken of Escher, Wyss & Co., of Zurich. The latter company, which is largely concerned with the construction of hydraulic turbines, is also the owner of the Zoelly steam turbine patents which the company works in Switzerland, while in Germany the patents are utilised by the Zoelly turbine syndicate, which is controlled by Friedrich Krupp & Co., the Siemens-Schuckert Works and other companies, and which has still 17 years to run. It is understood that the principal reasons for the German acquisition of the shares in the Swiss company are to be found in the former's desire to at once become capable of competing in the steam turbine branch, and also to come into close association with the existing Zoelly turbine syndicates. The total share capital of the Swiss company amounts to £200,000, and the German company have acquired 95 per cent., partly by cash payment and partly by an exchange of shares. The new order of affairs has led to the retirement of certain of the directors of Escher, Wyss & Co., and to the assumption of office of representatives of German interests. Notwithstanding the transfer of the majority of the shares, the Zurich undertaking will continue as a Swiss company, and the management remains in the same hands as hitherto.

Oerlikon Installations.—From the Maschinenfabrik Oerlikon, Oswaldestre House, London, W.C., we have received a copy of a periodical communication, No. 24, giving a few descriptive points concerning some of the installations that are at present being carried out by the company. One is the Valle-Maggia Railway between Locarbo and Bignasco, which is being equipped with Oerlikon single-phase motors of 40 H.P. output, and with Oerlikon patented collectors. The trolley pressure is to be 5,000 volts, and apart from the Seebach-Wettingen experimental line, also built by the Maschinenfabrik Oerlikon, and working at a pressure of 15,000 volts, this is the highest trolley pressure up to now authorised by the Swiss Federal Railway authorities.

Another installation is the 50,000-volt power transmission for the city of Seville. The line is 80 miles long, and has to transmit power from three 1,500-H.P. hydro-electric units, running at a speed of 400 r.p.m., 40 cycles, 5,000 volts. Three single-phase transformers of 600 K.V.A. output are at present coupled to each end of the line, a seventh being ordered as a spare. There is also mentioned the installation of the Société de l'Industrie Electrique de la Valnerina, Terni, which will ultimately dispose of 10,000 H.P. Five generators, the order for which has been given to the Maschinenfabrik Oerlikon, are of the three-phase revolving field type of 1,900 K.V.A. capacity step up the pressure to 30,000 volts; 650-K.V.A. single-phase transformers connected up in mesh, step down the pressure to 550 volts. The same company has further received the order for the equipment of the electric railway from Zug-Zugerberg, and for the installation of the electricity works of the city of Sion, as well as for machinery and apparatus for the electricity works of Taulan, &c.

New Lamp.—A new form of tantalum lamp, known as the "tantalyte," has been put on the market by Messrs. Krupka and Jacoby, of Watling Street, E.C. It consists of a happy combination of the Sun tantalum lamp, and a specially shaped opal shade, which, being in proper focus, collects the light rays and redistributes them with concentrated power (viz., 130 candles). It is claimed that the watts per candle-power are only ·5.

Gas Engine Plant of the Indiana Steel Co.—Eight large gas-driven blowing engines are to be installed in the steel plant of the Indiana Steel Co., at Gary, Indiana. It is the expressed intention of the U.S. Steel Corporation, which controls the Indiana Steel Co., to make this the foremost American steel centre, and the significance of simultaneous development of gas power is obvious. The machines will be uniform in size and capacity. Each gas engine, as an electric unit, will have a rated capacity on blast furnace gas of nearly 3,000 H.P., corresponding to a rating of 4,000 H.P. on natural gas. The unit will be arranged in twin tandem fashion, each side consisting of two double-acting gas cylinders and one blowing cylinder in the opposed or *vis-à-vis* arrangement. The power cylinders are 42 in., and the air cylinders 68 in. in diameter with a common stroke of 54 in., the unit running at a maximum speed of 75 r.p.m. for blowing, and 84 r.p.m. for electric work. The capacity of air delivery at this speed will be 33,000 cb. ft. of free air per minute at 28 lb. pressure, with a maximum pressure delivery of 30 lb. per sq. in. This type of engine will not only be used for blowing purposes, but also for electrical generation. In all sizes the resemblance to the horizontal tandem heavy duty steam engine design is strong. The general design conforms quite closely to that of similar machinery installed for the Carnegie Steel Co.'s plant (U.S. Steel Corporation) at Bessemer, near Pittsburg. The Westinghouse Machine Co. are the contractors in both cases.

Catalogues and Lists.—Messrs. Ernest F. Moy, Ltd., Camden Town, N.W.—List No. 12 (32 pp.) containing a good deal of information, together with dimensional and other drawings, also tabulated prices concerning their various types of rheostats, motor-starters, and resistances.

Messrs. Bruce Peebles & Co., Ltd., 1, London Wall Buildings, E.C.—New pamphlet No. 16, whose 28 pp. of thick art paper contain a well-illustrated and neatly-arranged description of their latest type of P.P.P. induction motor. The principle of the motor being first explained briefly, the self-contained, open and enclosed ventilated types are shown, views of the component parts and typical performance curves following. Particulars of two-phase motors are also given, and at the end of the pamphlet a number of pages are set apart for clearly-arranged tables giving speeds, efficiencies, power factors, weights and prices of two and three-phase squirrel-cage motors of the self-contained protected type.

The British Steel Piling Co., Dock House, Billiter Street, E.C.—Interesting illustrated catalogue relating to "Steel Piling." A description of the company's system of interlocking channel bar piling, its construction, properties, advantages, &c. Some of the photographs show the application of the system in the construction of a coffer dam for an American electric light company.

Messrs. J. Armfield & Co., Vale of Avon Ironworks, Ringwood, Hants.—Illustrated catalogue (Section A, 32 pp.) describing their "British Empire" water turbines of single and double horizontal and vertical types, direct-driving turbine for electric generators, also their mechanical turbine governor, and indicating hand gear for turbines. Dimensional particulars are stated in table form. Some general information concerning the measurement of water, prices and particulars of Pelton wheels, also appear, and views are published of a number of typical mills where the "British Empire" turbines are in service. The extensive use of these turbines is indicated on a map of England and Wales, and a number of users are named.

British Thomson-Houston Co., Ltd., Rugby.—Price list No. 104 (24 pp.) in the company's standard form and style giving in conveniently arranged table form a list of prices and catalogue numbers of their overhead line material devices embodying recent improvements. Various forms of suspensions, deep grooved ears, ears for grooved wire, including the B.T.-H. flexible ear, terminal clamps, strain insulators, and turnbuckles, frogs and crossings, section insulators, flexible suspension clamps and pole insulators are all included, appropriate illustrations appearing in each section.

Messrs. Adam Hilger, Ltd., 75A, Camden Road, N.W.—List "A" (44 pages), giving well set-out illustrated descriptions of their spectroscopes and spectroscopic accessories. The various instruments shown include table, universal, wave-length and automatic spectroscopes, spectrographs, solar and stellar spectroscopes, spectro-photometers, &c. Vacuum tubes and micrometers are also particularised. List "B," also received from this firm, contains an account of their echelon diffraction gratings.

Messrs. Falk, Stadelmann & Co., Ltd., London, E.C.—List of revised prices of tumbler switches, also a table of prices of "Climax" electric light wires and cables.

Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—Pamphlet No. 34, describing their lever type totally enclosed motor starter.

Meter Reading Books.—In reply to our correspondent "O. K." on this subject, Messrs. Hammond & Stow, Ltd., of Sise Lane, 35D, Queen Victoria Street, E.C., inform us that they are patentees and sole publishers of a loose-leaf meter reading book, which they believe will answer all his wants.

Annual Outings.—On 21st ult. the employés of the Cardiff Corporation Electric Lighting Department held their tenth annual picnic at Glynneath and Pontneathvaughan.

The Sunbeam Co.'s workmen's annual excursion took place on Saturday last, July 28th, Brampton having been selected as a *rendezvous*. Cloud and brilliant sunshine alternated during the day, presenting to the trippers the hills and country in varying aspects and ever-changing phases. Some found enjoyment in rambling over the hills, boating was indulged in on the Tarn by not a few, while others sought pleasure in a plunge in its cool waters. Then there were the usual "items"—the quoit handicap, and other forms of sport to test the skill and athletic fitness of the members of the party. Ample justice was done to the midday meal, and tea was served in the afternoon. The principal toast, "The Sunbeam Lamp Co.," was entrusted to Mr. W. Young, Mr. T. J. Grainger (secretary) and Mr. H. Edmundson responding. The former in his remarks referred again to the insane competition which prevailed among the English lamp makers. He concluded by an optimistic and hopeful expression for the future of their company. Mr. Edmundson added a few observations, remarking that so long as the commercial interests of the firm were in the hands of Mr. Grainger—a man of unwearying endeavour and business acumen—and they in the manufacturing departments did their part and tried to turn out the best lamp, continued prosperity was assured.

The staff and employés of Messrs. T. Clarke & Co., electrical engineers, of 129, Sloane Street, Chelsea, S.W., had their fourteenth annual excursion on Saturday last, enjoying delightful weather. A large party travelled to Bognor, arriving in good time for breakfast. During the morning a cricket match was played on the sands. Dinner was served at the Waterloo Hotel, presided over by Mr. T. Clarke, and Mr. E. J. Clarke in the vice-chair. Sports were held during the afternoon, in which a great number of the men took part, and the party journeyed back to town at eight p.m., after a most enjoyable and happy day.

France.—A company has recently been formed in Paris with a capital of £80,000 and the title La Société Française pour l'Industrie d'Aluminium.

Self-Exciting Self-Regulating Three-phase Alternators.—The Lahmeyer Electrical Co., Ltd., of 109-111, New Oxford Street, W.C., have introduced a "Heyland" three-phase alternator in small sizes—up to 15 H.P.—so that the advantages of three-phase supply are thus made available even to small isolated installations. These alternators are both self-exciting and self-regulating, so that when driven at constant speed they require no attention. The floor space occupied is very small, and the machines light, rendering heavy foundations superfluous.

A Remedy for the Motor-'Bus Nuisance.—A device intended to put an end to the vile-smelling "visible vapour" emitted by the noxious vehicles which rattle and limp through our thoroughfares has been shown to us by the inventor and patentee, Mr. F. H. Lavaggi, whose address is care of Messrs. Feldman, 34, New Bridge Street, E.C. It takes the form of a high and low oil electric alarm, and consists of a small reservoir, in communication with the crank chamber of the petrol motor by way of a flexible tube, and containing a float. The latter rises or falls in accordance with the variations of level of the oil in the crank chamber; when the oil is too high, an electric circuit is completed which lights a red lamp on the dashboard, and when the oil is too low a white lamp is similarly lighted. The absence of a light indicates that the level of the oil is between the normal limits; it might mean that the circuit was broken, but a check test is provided to enable the driver to satisfy himself that the apparatus is in working order. It is, of course, necessary that the air in the space above the oil in the reservoir shall be at the same pressure as in the upper part of the crank chamber, either by means of a pipe connection, or more simply by both being open to the atmosphere. The device is all right in principle, and we understand that it has proved successful in practice. Anything that helps to cleanse our once fresh air from the horrible oil fumes with which it is nowadays defiled is worthy of commendation, and we are pleased to welcome Electricity in her favourite *rôle* of benefactress of suffering humanity.

Holidays.—The works of the Rhodes Electrical Manufacturing Co., Ltd., will be closed for the summer holidays for the week commencing August 6th.

Street Lighting at Southport.—Southport has, from the very first, realised the importance of good illumination of its streets, and for the last 11 years has used arc lamps for the lighting of its main thoroughfares and promenade. Early last year it decided to make an extensive experiment with improved arc lamps, and it, therefore, lit the whole of Lord Street (which is one of the finest thoroughfares in England), with Excello arc lamps. There were two interlacing circuits, each of 15 12-ampere lamps, in series on 750 volts supplied from a constant-pressure transformer, which gave such satisfactien that it was decided this spring, after a year's practical trial, to replace all the 15-ampere white arc lamps by a further supply of Excello lamps. The original open-type white arc lamps were supplied in series with rectified current from a constant-current transformer. As with Excello arc lamps there is no gain in illuminating effect by rectification of the current, due to the fact that both the crater tips project downwards, it was decided to remove the rectifier and to supply the new circuits through the constant-current transformers alone. The new installation, which includes circuits of 36 Excello arc lamps in series, was put to work on Friday of last week, and from that date the Promenade, Lord Street, Eastbank Street, Church Street, &c., have been entirely lit with the Excello arc lamps.

The economy of this new method of lighting is considerable; a circuit of 36 Excello arc lamps of 12-amperes capacity, complete with the safety coils coupled in parallel with each lamp, took, under careful test, only 19·25 KW., that is to say, slightly less than 540 watts per lamp. This is the first installation of Excello arc lamps run on this principle. Mr. R. S. Downe, the borough electrical engineer at Southport, designed the installation, which the UNION ELECTRIC CO., LTD., were called upon to carry out.

Quick Cable Laying.—The BRITISH INSULATED AND HELSBY CABLES, LTD., have just carried through in very quick time the contract of which particulars follow. On June 14th, 1906, the North Metropolitan Electric Power Supply Co., Ltd., placed an order with them to supply and lay trunk cables to connect their Hendon and Finchley sub-stations, and so to enable their transmission system to be supplied from either their Brimsdown or their Willesden (Taylor's Lane) power station. The order was for 9¼ miles of 1 in. extra high-tension three-core 11,000-volt cable, and 4⅝ miles of eight-core telephone cable, in both cases the cables being plain lead-covered, and 4⅝ miles of trench work and temporary reinstatement, of which about 95 per cent. was under road surfaces. The E.H.T. cable was to be laid in a 3½-in. socketed glazed earthenware trough, and the telephone cable in tarred wooden troughing. A portion of the earthenware troughing and tile covers was obtained from various makers' stocks, but the remainder and all the wooden troughing had to be built. Different thicknesses of tile covers were used, so as to distinguish clearly one cable from another at any point of the route. All the cables had to be manufactured, and the dispatch of E.H.T. and telephone cable was made from Prescot exactly 14 days after receipt of the order. Laying commenced on July 3rd, and being favoured with good weather from start to finish, the work was completed ready for testing by the evening of July 27th—*i.e.*, six weeks and one day after receipt of the order. The cables were ready for, and were actually put under working pressure on Saturday, July 28th. The number of men employed on the work was approximately 230, divided into two gangs. Overtime was worked when necessary, but there was practically no night work, except keeping the jointers at work through the night on two occasions only.

Theft of Telephone Wires.—A man named Alfred Simmonds has been committed for trial on a charge of stealing a quantity—about 50 lb.—of telephone wires belonging to the National Telephone Co., near Redhill, Surrey. The prisoner has been identified by finger prints with J. J. Fletcher, who had previously received 12 months' hard labour for stealing telephone wires.

Bankruptcy Proceedings.—B. W. SHERMAN.—Under the failure of Bernard Williamson Sherman, electrical engineer, 27, Chancery Lane, W.C., and North Road, Seven Kings, the first meeting of creditors was held last week at the London Bankruptcy Court before Mr. E. S. Grey, Official Receiver. According to the debtor's statement, he was for eight years in the employ of the National Telephone Co., and in 1902 he started on his own account at 16-17, Devonshire Square, E.C., as a telephone specialist and electrical engineer, with a capital of £270. He carried on that business until December, 1905, when the landlord distrained for £20 arrears of rent, and sold up everything upon the premises. The debtor in 1903 bought a dry battery company, and sold it to the Amalgamated Dry Batteries, Ltd., at a profit in shares. He still holds 2,508 shares, which are pledged. He also bought and sold an Electric Flash Light patent. The statement of affairs was not lodged, but the debtor roughly estimates his unsecured debts at £900 and his assets at £5,000, that being the surplus value he attaches to his share holding in the Amalgamated Dry Batteries, Ltd. He ascribes his appearance at the Court to inability to realise his assets and losses in business in connection with patents. The creditors left the matter in the hands of the Official Receiver to be wound up in bankruptcy, the debtor's public examination being fixed for August 28th.

LAZARUS BLUMENTHAL, electrical merchant, 78, Queen Victoria Street, E.C.—A receiving order was made on July 24th on a creditor's petition. The first meeting is to be held on August 13th, and the public examination on September 11th, both at Carey Street.

WILLIAM LESLIE, electrical engineer, "now of H.M. Prison, Brixton." Last day for receiving proofs for intended dividends (separate estate), August 14th. Trustee, H. W. Figg, 128A, Queen Victoria Street, E.C.

On the 27th ult. an order was made in the case of HARRY JONES, electrical engineer, lately trading as H. Jones & Co., Stoke-upon-Trent and Longton.

Dissolutions and Liqidations.—The ELECTRICAL CORPORATION, LTD.—A petition for winding up this company (presented by Messrs. O. C. Hawkes, Ltd., Birmingham, creditors) is to be heard in London on 7th inst.

Notice is given in the *London Gazette* that a general meeting of the YORKSHIRE ELECTRIC TRAMWAYS CONSTRUCTION SYNDICATE, LTD., will be held at the office of the company, 14, Victoria Street, S.W., on September 5th, at 3 p.m., to receive the report of the liquidator as to the winding-up of the syndicate.

ELECTRO-MEDICAL SUPPLY CO., LTD.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. H. Crewdson Howard, 70A, Basinghall Street, E.C.), by September 14th.

NATIONAL ELECTRIC TRACTION CO., LTD.—A meeting is to be held at 79, Queen Street, Cheapside, E.C., on August 29th, to hear an account of the winding-up from the liquidator, Mr. Leslie Morse.

For Sale.—The Coventry Corporation is offering several engines, alternators and grease separators for sale. The alternators are 100, 200 and 300 KW. The plant is being sold to make room for larger sets. Some particulars appear among our advertisements to-day.

Book Notices.—"Science Abstracts." Parts A and B. Vol. 9, No. 7, July 25th, 1906. London: E. & F. N. Spon, Ltd. 1s. 6d. each part.

"Journal of the Institution of Electrical Engineers." Vol. 36, No. 178, July, 1906. London: E. & F. N. Spon, Ltd. 5s. net.

"Transactions of the South Yorkshire Association of Mining Students." Vol. 1, No. 4, July 2nd, 1906. London: The *Colliery Guardian* Co.

"Engineering Press Monthly Index Review." Vol. VIII, No. 4, July, 1906. Brussels: Association de la Presse Technique. 2.50 fr.

Trade Announcements.—MESSRS. EVERSHED AND VIGNOLES, LTD., have appointed Mr. James Ferguson, 61, Pollok Street, Pollokshaws, Glasgow, their agent for Scotland. Messrs. C. H. B. Forbes & Co., of Bombay, have been appointed their agents for the City and Presidency of Bombay.

The offices of the Acton District Council Electricity Department have been removed to 130, Churchfield Road, Acton, and all correspondence should be addressed there in future.

We are informed that Mr. PERCY GOOD has severed his connection with the Electrical Testing Institution, Faraday House, and is now in partnership with Mr. C. E. Newton, trading as Neville & Co., 11, Queen Victoria Street, E.C., and manufacturing insulating varnishes and materials.

MESSRS. ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO., LTD., Birmingham, announce that their works will be closed for stock-taking from 4th to 11th inst.

LIGHTING and POWER NOTES.

Barking.—The U.D.C. has applied to the B. of T. for powers to hire out electrical apparatus.

Belfast.—The accounts of the Corporation electricity supply undertaking for the year ended March 31st last have been recently issued, and the results of the past year's working in brief are as follows:—

Year ended March 31st	1906.	1905.
Total revenue	£37,452	£28,252
,, working costs	17,227	11,268
Gross profit	20,225	16,984
Interest	7,845	7,782
Sinking fund	5,689	4,845
Net profit	6,692	4,357
Capital expended	261,032	252,736
No. of 8-C.P. lamps	235,774	189,846
Units sold	4,502,049	2,290,872
Maximum load	4,375 KW.	2,243 KW.
Capacity of plant	6,400 KW.	3,400 KW.
Average price obtained—		
Private lighting	2·86d.	2·89d.
Public lighting	1·65d.	1·64d.
Traction	·79d.	—

It will be observed that the output is largely increased, owing to the introduction of electric traction, which, however, was only in operation for the last four months of the past financial year. The net profit has also increased to the extent of £2,335. Mr. V. A. H. M'Cowen, the city electrical engineer, will undoubtedly be able to show an even better account next year. The new plant for the tramway supply was working non-condensing for the first three months, owing to the works being incompleted. The average price obtained for traction supply appears somewhat low.

The Harbour Commissioners have recently added two electric cranes for facilitating the discharge of coal vessels on the Queen's Quay. Each is capable of lifting a load of four tons at a radius of 50 ft., the jibhead being 45 ft. above the level of the quay. Each crane is mounted upon a gantry, which is 14 ft. in height, to the underside of its girders. The motions provided for are lifting, lowering, revolving, derricking, and travelling, each motion being worked by a separate electric motor. The load is lifted by means of a 70-H.P. motor running at 650 r.p.m., the lifting speed being 180 ft. per minute. The grab has a capacity of about 35 cwt. The revolving gear is worked by a 10-H.P. reversible motor, and the travelling gear also by a 10-H.P. motor. A 9-H.P. reversible motor operates the derricking gear. The motors are series wound, for a pressure of 440 volts. The controllers are of the tramway type, with magnetic blow-out windings. The cranes were constructed by Messrs. J. H. Wilson & Co., of Liverpool.

Bideford.—Three companies have informed the T.C. that they intend applying for prov. orders for E.L.

Bray.—At a recent meeting of the U.D.C., a member moved that steps be taken to dispose of the E.L. undertaking, and the matter was referred to a Special Committee for consideration.

Bristol.—On the 27th ult., Mr. H. R. Hooper conducted a L.G.B. inquiry into an application of the Corporation to borrow £103,554 for E.L. purposes, made up as follows:—£10,400 for Temple Back, £57,100 for Avonbank, £40,800 for the distribution system, and £4,746 for loans adjustment. Details in regard to the Temple Back sum were asked for, and in regard to the Avonbank figure, £12,200 is required for superstructure, £32,130 for engine room plant, £9,682 for boiler house plant, and £3,039

for contingencies. For this station two cranes are required, and the inspector questioned Mr. Proctor as to the necessity for two. In reply, "two might not be necessary, but were certainly desirable." As is customary with Mr. Hooper, full details were required in regard to the various sums; these were not available. The inquiry was adjourned until September 20th next.

Canada.—MONTREAL.—An electrical exhibition is to be held for one week—September 17th to 22nd next—in the Victoria Rink, Central Market. It will be under the auspices of the Electrical Contractors' Association.

Ceylon.—The draft of a proposed ordinance to make better provision for facilitating and regulating the supply and use of electrical energy for lighting, traction, and other purposes, is published in the *Official Gazette*.

Continental Notes.—SWEDEN.—The German Consul at Malmö has drawn attention to the establishment of the Sydsvenska Kraft Aktiebolag, which is to supply electric power to the towns of Malmö, Lund, Landscrona, Helsingborg and Halmstad from the River Lagan. The Consul is of opinion that the extension of such enterprises will offer great openings for German electric plant and apparatus.

The company intends to improve the falls so that they may furnish about 14,000 H.P., and in the future about 30,000 H.P.; and it is intended to supply this power so cheaply as to exclude competition from any other source of power at present available.

AUSTRIA-HUNGARY.—It is stated that a scheme is on foot in Dalmatia to utilise the power of the Duara waterfall. It is proposed, with the assistance of foreign capitalists, to erect a plant of about 50,000 H.P.

ITALY.—The authorities of the Province of Massa have granted a concession for a water-power plant to be put down on the River Rosara for lighting and power purposes at Fiozzano.

GERMANY.—Plans are being prepared in respect of a joint electricity generating station which it is proposed to establish at Drochtersen (Hanover) for the electric lighting of that town, Niedorf and Dornbusch.

Coventry.—The past year's working of the electricity department has resulted in a net profit of £2,603, against a loss last year of £229. The capital expended during the year has been £18,182, bringing the total expenditure to date up to £152,685. During the year the number of consumers increased from 637 to 805, and the equivalent of lamps connected from 71,727 (8-C.P.) to 102,883. The number of units sold increased from 1,375,735 to 2,522,110, and the revenue from sale of energy from £13,248 in 1905, to £19,493 in 1906. The gross profit amounted to £11,973, as against £8,217 last year. Capital charges amounted to £9,481, against £8,629 last year. There is a balance in the hands of the treasurer on net revenue account of £3,736, and the Committee has recommended that this be dealt with as follows: (1) That £850 be repaid to the general district fund, being the amount paid over from the fund to meet deficiencies; (2) That the balance of £2,886 be paid to reserve fund and transferred from that fund to capital account.

Derby.—A L.G.B. inquiry was held recently into the application of the T.C. to borrow £8,490 for E.L. purposes. The amount included £3,360 for mains, £600 for services, £490 for a spare armature, £1,500 for motors, £200 for radiators, £200 for transformers, £1,180 for meters, and £360 for lighting Upper Dale Road. During the inquiry the inspector was informed that the net profit on the year's working ended March last, was £969.

Eastbourne.—The Finance Committee will, with the usual sanction, apply to the L.G.B. for power to borrow £11,269, required as follows:—(1) For capital expenditure already incurred in connection with electric light extension, £6,726; (2) for estimated expenditure during the ensuing twelve months, £4,093; and (3) amount payable to Mr. Freeman-Thomas, M.P., for cables in Willingdon, £450.

Halifax.—A new three-wire feeder for lighting purposes is to be laid from the works to George Street sub-station at a cost of about £1,352.

Hastings.—It is understood that the L.G.B. has refused to sanction the loan of £563 applied for by the T.C. for E.L. in Queen's and Cambridge Roads and portions of London Road and Sedlescombe Road North. It was proposed to install Oliver "Flame" lamps, and at the inquiry the Inspector drew attention to the fact that the price charged for electric lamps at Hastings was the highest in the country, and it was now coming down to nearly the lowest.

Ilford.—The U.D.C. has, on the advice of its electrical engineer, decided that the charges for power purposes as from the end of September next shall be:—(1) On the maximum demand system—For the first 100 hours' use per quarter 2d. per unit; all over this amount, 1d. per unit. (2) On the sliding scale—For first 500 units per quarter, 2d. per unit; for next 1,000 units 1½d. per unit; for next 1,000 units, 1¼d. per unit; all over above amount, 1d. per unit. Councillor Stroud protested against the higher prices which had to be paid by some who had the slot meters. The report of the committee was then adopted, the engineer's suggestions to take effect from the end of September.

Lancashire Collieries.—Extensive electrical installations have been put down at the Douglas Bank Collieries, Wigan, at the Hulton Colliery Co.'s Chequerbent and Atherton pits and at the Westhoughton Coal and Cannel Co.'s collieries at Westhoughton. The last-named are contemplating increasing their electrical plant.

Leeds.—The Leeds Co-operative Society, which runs its own electric lighting plant, reports a loss of £45 during the first half of the current year on a supply of electricity to the value of £300 to its own departments.

London.—MARYLEBONE.—The annual statement of accounts of the electric supply undertaking for the year ended March 31st last has been issued. The previous statement was circulated in October last, and the debit balance was then shown to be £5,176. The estimate of income and expenditure for the year ending March 31st, 1906, showed an income of £97,693 and an expenditure of £95,891; the actual income was, however, £105,081, and the actual expenditure £92,640. Even when the position was more clearly ascertainable at the beginning of March last, the estimated net results were given at £6,062 less than has been realised, and the improvement was wholly due to the better conditions that obtained during the March quarter. The year's operations had resulted in a net credit balance of £12,441. The Council did not commence the supply from its new generating station until August 6th last, prior to which date the Metropolitan Electric Supply Co. was supplying the whole of the consumers under the terms of the working agreement, and since the above date the consumers have only from time to time been transferred to the Council's source of supply. The electrical accountant informed the Committee that an approximate division of the year's income and expenditure as at August 6th, shows a loss to that date of £5,300, and a profit since of £17,741. The gratifying results shown on the revenue account had been achieved after providing for certain special expenditure amounting to £2,331. All interest charges accruing during the construction period and all establishment charges during the same period had been met out of revenue account. The cost per unit sold over the whole period, worked out at 1·601d., exclusive of capital charges and interest on the award, but during the March quarter, when the consumers were being taken over daily, the results work out to the equivalent of 1·313d. per unit for an approximate annual output of 5,600,000 units. The financial position at March 31st last was, therefore, that the profit of £12,441 on the year had enabled the debit balance of 12 months ago, £5,143, to be wiped off, leaving a balance in hand of £7,298. In view of subsequent economies and more favourable conditions, the Committee believes that the undertaking is capable of achieving successful financial results. The Committee has decided to carry forward the balance of £7,298 to the current year's accounts.

The Council is to pay the St. Helens Cable Co. £1,000 for extra expenses occasioned by the delay in commencing the work of laying the mains under its contract. The company claimed £1,350, but afterwards agreed to accept the lesser sum.

From the end of September the following charges for energy are to come into force:—Lighting, 8d. per unit for 500 hours' use of the maximum demand, and 1d. per unit for all in excess of this quantity during each year; for purposes other than lighting, 2d. per unit for 125 hours' use of the maximum demand in each quarter, and 1d. per unit afterwards; basement lighting, a flat rate of 2d. per unit. All consumers are to be allowed 25 per cent. discount off the excess of each quarter's account above £50, provided that such accounts are settled within 30 days of their being rendered, and that all outstanding claims against the Council on account of the change of pressure are withdrawn. The option is to be given to all consumers who were supplied previous to August, 1905, to remain on their present scale of charges until September, 1907. The Council is to offer to install and supply, through wiring contractors, not less than two pairs of 50-watt lamps to any new and approved consumer for an inclusive charge of 20s. per 50-watt lamp per annum to cover the use of the wiring and the supply of electricity up to 1,500 hours a year. All new lamps are to be paid for by the consumer, and electricity consumed in excess of the above quantity to be paid for at 1d. per unit.

CAMBERWELL.—A statutory meeting of the B.C. has been convened for September 19th, to authorise the town clerk to make application to the B. of T. for a prov. order under the E.L. Acts, 1882-8. A vigorous agitation has been commenced against the proposal, and at the last meeting of the B.C., deputations from local Ratepayers' Associations urged that electric lighting matters should be left to private enterprise. Subsequently a largely attended meeting was held outside the Town Hall, when speeches denouncing the Council's scheme were loudly applauded.

In a report recently circulated, it was stated that the decision to convene the meeting was arrived at as a result of the conference of the Works, General Purposes, Finance, and Public Health Committees. The conference considered a long communication from Alderman Hearson, Chairman of the Works Committee, which, pointed out that the charges for energy compared unfavourably in those parts of the borough where there was no competition with the charges where there were two competing companies, and that the County of London Electric Supply Co. had been unduly favoured by the B. of T., and the Government which was formerly at the back of the B. of T. "In view of the fact that there are now other influences at work at the Board, it appears to me," Alderman Hearson continued, "that the moment is opportune

to appeal to that body to do justice to Camberwell by either granting an order for the whole of Camberwell independently of any other consideration, or as an alternative to grant an order with the provision that the borough take over the undertaking of one of the competing companies, namely, the London Electric Supply Corporation, leaving out that portion of the borough at present supplied by the South Metropolitan E.L. and Power Co. There is in the latter suggestion nothing which conflicts with the principles upon which the B. of T. is presumed to act, and the advantage of this course to the borough lies in the fact that the London Electric Supply Corporation's mains are already laid in the competing area, that there is an assured income in that area, that ratepayers who are now supplied in that area by the County of London Electric Supply Co., would in all probability come over to the B.C., even at the same rate of charge, and thus materially increase the Council's revenue, and that ratepayers would be more ready to support a municipal undertaking, and a larger consumption would naturally follow. The purchase of the company's undertaking also commends itself from the fact that the mains are already down, and the further disturbance of roadways and pavements would thus be avoided, save for purposes of extension. It will not, of course, be lost sight of that there is no installation within the borough for the generation of electricity belonging to either of the electric light companies I have referred to, and I may remind you that the London Electric Supply Corporation's original offer included the furnishing of a supply of energy in bulk at a fixed rate for a specified time, and this arrangement if carried out, would probably fit in with the views now prevalent at the L.C.C., which is to supply the Borough Councils at prices which would enable them to compete on equal terms with the other electric light companies. Taking all these points into consideration, it appears to me that it is desirable for the Council to obtain a footing so as to be in a position to secure both for ratepayers and consumers whatever advantages are to be derived from the next County Council Bill, and to do that I desire to get the approval of the Committee to one or other of the courses I have mapped out." The conference also considered a report from the town clerk on the matter, which stated that so far as he could make out the total expenditure of the County of London Co. for the whole period of its existence in Camberwell up to December 31st last was £192,798. The net expenditure of the company last year was £3,367, and the income £13,685, leaving a balance to be carried forward of £10,318, as against £9,745 the previous year.

Stepney.—The E.L. Committee has informed the Council that it has carefully considered the resolution passed by the Council in June, asking it to consider whether the engagement of the consulting electrical engineer could be advantageously terminated. The Committee stated that if the undertaking continued to develop at the same rate as at present the maximum load capacity of the station would be reached in 1907. The Council would, therefore, soon have to consider the question of adopting one of the following two expedients—viz., (1) of taking the necessary steps to erect a second station, or (2) of taking a bulk supply; and in the light of these developments, the Committee was unanimously of opinion that the engagement of the consulting engineer cannot now be advantageously terminated.

Westminster.—In spite of the Works Committee's recommendation that the City Council should accept the tender of the Westminster Electric Supply Corporation for lighting Whitehall and Parliament Street, the City authority has decided, by the narrow majority of one vote, to continue with gas. During the discussion Mr. Gatti said that he had authority for stating that the S.E. & C.R. Co. had resolved, after a series of exhaustive tests carried out by impartial experts, to light Charing Cross Railway Station with electricity.

L.C.C.—The Highways Committee has proposed that the B. of T. be approached with a view to urging the necessity of further legislation to provide that no electricity meter shall be fixed for use unless it has previously been tested and stamped by the Council.

Islington.—A proposal was put forward recently that financial and technical experts should be engaged to inquire into the working of the electricity undertaking, the management of which had been criticised by some of the members of the B.C. The motion, however, was lost.

Luton.—The T.C. has received from the L.G.B. sanction to a loan of £7,000 for electricity purposes.

Maidstone.—The T.C. has applied to the L.G.B. for a loan of £1,500 for condensing plant and buildings.

Mansfield.—The result of the past year's working of the Corporation electricity undertaking is a deficit of £758.

Mexico.—Application has been made to the Mexican Government for a concession for the erection of a plant on the River Tecolapa (State of Vera Cruz) for the generation of electrical energy for power purposes.

Middlesbrough.—The E.L. Committee of the T.C. has decided to recommend a reduction of ½d. per unit to consumers of over 1,000 units per quarter.

Provisional Orders.—Application is to be made for E.L. powers for the following districts, and the local authorities have been notified by the applicants:—

Amersham.—The Empire Electric Light and Power Co.
Dunstable.—Messrs. Foote & Milne. The T. C. has decided to oppose the application.
Eastleigh and Bishopstoke.—The Mutual Electricity Supply Co.
Farnham.—The Camberley Electric Supply Co.
Leighton Buzzard.—The Mutual Electricity Supply Co.
Woodhall Spa.—Messrs. Foote & Milne.

Pudsey.—The Electricity Committee of the Corporation reports a loss of £217 on its trading for the period of 15 months ended in June. For five months during this period, we understand, the undertaking, which is a bulk supply, was not earning any revenue.

Rawmarsh.—The *London Gazette* for July 27th contains notice of the intention of the U.D.C. to transfer its prov. order to the Mexborough and Swinton Tramways Co. for 42 years.

Rochdale.—The Electricity Committee of the Town Council has decided to extend the electricity supply to the Castleton district at an estimated cost of £2,000.

South Africa.—Kroonstad.—The Mayor recently inaugurated the new generating set installed by Messrs. Hubert Davies & Spain.

Stoke-on-Trent.—As the result of an appeal the assessment of the Corporation electricity works has been reduced from £550 to £500.

Walthamstow.—Application has been made to the L.G.B. for sanction to borrow £16,775. The chief items upon which it is proposed to expend this sum are as follows:—Boilers, £3,150; engine and dynamo, £4,400; switchboard extension, £650; purifying plant, £515; grease-extracting plant, £515; buildings, £800; and main steam pipe, £350. A sub-committee of the Lighting Committee is to inspect the plant installed by Messrs. Henley's at Gravesend for the purpose of generating steam by means of exhaust gases.

Willesden.—The annual report of the U.D.C. Electricity Committee shows a loss of £860 on the working of the E.L. undertaking during the past year.

Wolverhampton.—To meet the increasing demand for electric power supply in the Dudley Road district, the Corporation Electricity Committee has decided to lay down an additional feeder from the works in Commercial Road at a cost of £2,500.

Woolwich.—The T.C. on July 26th decided to engage Sir A. B. W. Kennedy at a fee of 200 guineas to investigate the electricity undertaking and prepare a report.

TRAMWAY and RAILWAY NOTES.

Continental Notes.—Germany.—Plans are being prepared in respect of a projected electric tramway between Gevelsburg, Milspe, and Vorde.

Paris.—An outbreak of fire occurred in a junction box between Motte-Picquet and Cambronne stations on the Metropolitan Railway last week, which caused a stoppage of the traffic for about 20 minutes.

Dundee.—On the working of the Corporation tramways for the past year, the gross receipts amounted to £50,154, and the working expenses, including maintenance of lines, to £31,112, leaving a balance of £19,042. This sum has been appropriated in meeting interest, sinking fund and depreciation; £5,000 has been allocated to the fund for renewals; and the surplus of £242 has been carried to reserve. During the year, 1,005,911 miles were run, and 13,086,396 passengers were carried, being respective increases over last year of 72,905 miles, and 1,444,871 passengers.

The new tramway route along the Arbroath Road was officially inspected recently by Col. Von Donop, of the B. of T.

Durham.—Application has been made to the B. of T. for a year's extension of time for carrying out the Bishop Auckland, Shildon and Spennymoor Tramways Order, 1904, by the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Ltd. The Durham R.D.C. has decided to offer no objection.

Folkestone.—The B. of T. has granted the T.C. a three months' extension of the tramway order.

Gloucester.—By a large majority the T.C. on July 25th rejected a proposal that negotiations should be opened in order to ascertain upon what terms the tramway undertaking might be disposed of on lease or otherwise, to a company.

Halifax.—The Committee has decided, subject to the approval of the Corporation, to put down a line of tramway from the terminus at Mount Pellon to Mount Tabor, at an estimated cost of £10,752, and to instruct the borough electrical engineer to proceed with the work immediately.

Indignation is expressed at the dismissal of the motorman of the car which came to grief in the recent accident, and a member of the Corporation has decided to put a resolution to the next meeting of the T.C. that the action of the tramways manager is "harsh and unwarrantable."

Hastings.—A poll of the electors of the borough as to the advisability of the Corporation allowing the Tramways Co. to run cars on Sundays was taken last Saturday; 4,109 voted for them, and 2,689 against.

On Saturday last a line of tramways from the Front to Silverhill was opened.

The work of laying the tramways between Hastings and St Leonards, on the Dolter system, has been started. The work is to be pushed forward with vigour. Eventually a route connecting Hastings, from the fish market, with Bexhill will be in operation.

Japan.—The British Consul at Shimonoseki reports that the Japanese Government has sanctioned the construction of an electric railway in Moji, and its extension to Hakata is under consideration.—*Board of Trade Journal.*

King's Norton and Northfield.—The U.D.C. has resolved to apply to the Board of Trade for sanction to borrow £40,000 to cover the cost of the King's Heath and Moseley tramways. In regard to tenders for this work, see our "Contracts Closed" column to-day.

Liverpool.—A report by the Corporation auditors shows that the car receipts, for the year 1905-6, of the city tramways amounted to £550,083—an increase on the previous year of £9,233. The passengers carried numbered 119,123,644, an increase of 2,480,981. Notwithstanding this great additional traffic, the mileage run has been reduced to 12,066,963—a decrease of 99,456 miles as compared with 1904-5. The passenger receipts per mile averaged 10·940d., as against 10·669d. The revenue account shows a surplus of £175,677, leaving, after payment of sinking fund and interest charges, a net surplus of £75,959. Of this, two-thirds has been placed to the reserve fund, and the balance will be applied in relief of the city rates. The amount set aside for renewals and depreciation—£88,814—is equal to 7·68 per cent. on the capital sum expended on the undertaking. The reserve fund stands at £214,398.

A new length of track which has been laid in Everton Road, linking up West Derby Road with the tramways in Eastbourne Street, was officially inspected on the 26th ult. by Major Druitt, of the B. of T.

Llandudno.—The *Llandudno Advertiser* says that at a meeting held recently in Manchester of the unsecured creditors of the Llandudno and Colwyn Bay Electric Traction Co., Ltd, the arrangement under which the unsecured creditors receive a proportion of shares in the new company which has taken over the undertaking was accepted, and the formal resolution was unanimously passed. There is now, therefore, no legal difficulty in the way of the completion of the line by the new company, whose workmen are engaged upon it. The Llandudno and District E.T. Construction Co. has been before the public this week with an issue.

London.—ST. PANCRAS.—The B.C. has passed a motion to the effect that the L.C.C. be asked to make provision in its next year's financial requirements for the electrification of the remaining horse tramways in St. Pancras.

L.C.C.—At Tuesday's meeting an expenditure of £112,000 was sanctioned in connection with the construction of tramways over Westminster Bridge and along the Victoria Embankment.

Authority was sought by the Highways Committee to an expenditure of £10,200 for the provision of special brakes for 170 cars.

After the summer vacation the question will be considered of applying to Parliament for powers to construct further tramways of a total length of 32½ miles.

The Highways Committee submitted the accounts of the receipts and expenditure in connection with the tramways for the year ended March 31st, 1906. It appears that the total receipts from the southern tramways amounted to £782,210, of which £626,860 was obtained from the electric cars, and the total expenses reached £561,755, leaving a gross surplus of £220,455. Debt charges absorbed £174,863, income-tax £8,000 and £35,000 was transferred to the renewals reserve fund, leaving a net surplus of £2,319 to be carried to the appropriation account.

The total amount of the renewals reserve fund established in connection with the undertaking was, at the beginning of the year 1905-6, £66,207. Dividends on investments and interest on the bank balance of the fund, amounted during the year to £2,077, and, as indicated above, a further sum of £35,000 has been added to the fund during the year. The fund has not been drawn upon during the year, and the balance carried forward to the current year is £103,684.

No comparison of working expenses can be made with those of former years, owing to the different circumstances obtaining. It may be stated, however, that the total operating expenses for electric traction were £407,558, or 8·04d. per car-mile run, including £1,875 for special charges. The total expenses in connection with horse traction amounted to £154,198, or 10·83d. per car-mile run, including £830, representing part of the cost of removing the derelict London, Camberwell and Dulwich tramways. However, the working expenses for electric traction have been considerably higher than they are expected to be when the permanent generating station at Greenwich is used to full advantage and the use of temporary stations is wholly dispensed with.

The total number of passengers carried and the car-miles run during the year were 183,512,421 and 15,578,793 respectively, or 18,693,861 and 1,497,396 more than in 1904-5. The sub-division of these figures between electric and horse traction is as follows:—

	Electric traction.	Horse traction.	Total.
Number of passengers ...	141,845,555	41,666,866	183,512,421
Number of car-miles run...	12,164,292	3,414,501	15,578,793

Of the total number of passengers, 33·53 per cent. were carried at ½d. fares, 48·50 per cent. at 1d., 9·10d. per cent. at 1½d., 5·64 per cent. at 2d., 1·55 per cent. at 2½d., and 1·68 per cent. at 3d. The average fare per passenger was ·99d., as against ·97d. in 1904-5.

During the year a number of cars have been fitted with magnetic brakes, which make it possible for the cars to be run at a higher average speed than previously, with the result that the earnings of the cars have increased.

The northern tramways, which have now passed into the possession of the Council, yielded net receipts of £60,952 for the year. After deducting the debt charges there remained a surplus of £25,256, which sum has been carried to the appropriation account. As regards the Aldwych to Islington tramways, which were in operation for five weeks only, the receipts amounted to £2,394, and the working expenses to £2,076, leaving a surplus on working of £318. The proportion of debt charges for this period was £1,060, resulting in a net deficiency of £742.

The net profit on the whole system is as follows:—Surplus balance of the appropriation account on April 1st, 1835, £29,989, surplus revenue of £2,319 and £25,256, on the southern and northern systems respectively for the year 1905-6 increased this amount on March 31st, 1906, to a total of £57,565. From this sum is deducted the deficiency of £742 on the working of the Aldwych to Islington tramways, and £25,573 expended on the general account respectively. The net surplus balance on March 31st, 1906, then amounts to £31,249.

The construction of the Garratt Lane tramways is nearly completed, and it is hoped that the line will be opened at an early date. The electrification of the York Road tramways is also nearly completed, but it is feared that special track work required cannot be obtained until late in August.

On August 4th the B. of T. will inspect the completed lines from the Falcon to the Latchmere, from Tooting to Plough Road, and from Vauxhall to Westminster and the Borough. If the result of the inspection is satisfactory, the cars will commence running the next day.

The Highways Committee has appointed Sir Benjamin Baker as the Council's representative on the Committee which is to inquire into the effect of the working of the Greenwich power station upon the Observatory, and has arranged with Prof. C. V. Boys to act as scientific adviser to the Council. The Admiralty representatives on the Committee are Prof. J. A. Ewing and Lord Rosse.

Leyton.—The Tramways Committee has approved of the plans submitted by the Walthamstow U.D.C. as to junctions with its system being laid down at Hoe Street and Markhouse Road.

The tramways manager has reported that on June 25th the Leytonstone line, with 142 horses, 14 cars, and stores valued at £243, were taken over from the North Metropolitan Tramways Co.

In regard to training motormen, West Ham has agreed to provide a special car and inspector for the training of the Leyton drivers, upon the U.D.C. paying the cost of energy, wear and tear of car and track, and for any damage done, plus a reasonable acknowledgment for the facilities afforded.

In regard to through running with West Ham, the tramways manager is to confer with the tramways manager at West Ham and to prepare a report, leading to a conference between the two Committees concerned.

Luton.—An extension of a year for carrying out the tramways order has been granted to the T.C.

Manchester and Altrincham.—The first portion of the Altrincham extension—that is, from Stretford Village to Sale—was opened for traffic on Saturday last. Low fares are charged, and it is not unlikely that this line will be a strong competitor with the old Manchester and Altrincham Railway for local traffic. Rapid progress is being made with the further extension from Sale to West Timperley, which is on the boundary of Altrincham, and the intention is as soon as possible to complete the line to the centre of the town by way of Barrington Road. Most of the new cars are being fitted with the "Kno-wet" appliance for keeping the deck seats dry. Tests already made on other routes have proved this appliance to be satisfactory.

Midland Railway.—The *Railway Gazette* states that it is proposed to adopt single-phase alternating current in connection with electrification of the company's line between Lancaster and Heysham Harbour, a distance of about seven miles. It is intended to run an electric service for local traffic only, replacing the steam rail motor-cars now in use. The power station at Heysham is of sufficient capacity to supply energy for the scheme; it may be the first example of a single-phase line to be put into practical operation in the United Kingdom.

Musselburgh.—A communication has been put before the T.C. by the Musselburgh and District E.L. and Traction Co., stating that the Royal Assent to the B. of T. Confirmation Order, which included the Musselburgh Extension Order, was likely to be obtained within the next week or two, and that the company intended to apply for powers this autumn to construct a tramway to connect their two systems. The Council decided not to oppose the order on certain conditions being agreed to by the company.

Newcastle-on-Tyne.—During a violent thunderstorm on Tuesday last the tramway trolley wires were struck by lightning and fused.

Swansea.—The T.C. has decided to give notice to the tramways company requiring the sale of the tramway undertaking.

Todmorden.—The T.C. has decided to purchase four motor-omnibuses for service in the borough. The cost will be £1,000 each, and the entire management and working will entail a gross expenditure estimated at £3,000 a year.

Wallasey.—With the approval of the U.D.C., which controls the Wallasey tramways, a system of bonuses to employés has been brought into use. The desire of the Tramways Committee is to ensure as full co-operation as possible from employés in working the tramway service. Drivers and conductors therefore now receive a bonus as a reward for an economical use of power, for punctuality in the service, for maintaining the cars in a clean and tidy condition, and for general smartness and efficiency in the work.

Warrington.—The Light Railway Commissioners have submitted to the B. of T. for confirmation an order amending the Warrington and Northwich Light Railways Order, 1903, and extending the time limit for construction.

TELEGRAPH and TELEPHONE NOTES.

Australian Telephones.—The Federal Government has announced its intention to postpone for an indefinite period the toll telephone regulations.

Brighton.—By 36 votes to 2 the T.C. resolved last week to accept the Postmaster-General's offer of £49,000 for the telephone undertaking. The capital expended by the Corporation on the undertaking up to the end of March last amounted to £53,765; taking the sinking fund and other items into account, there will be a deficiency on the Postmaster-General's offer of about £2,500.

Canada.—The City Council of Ottawa has accepted the offer of the Bell Telephone Co. for a five-year exclusive franchise, with the privilege of cancellation by the city at the end of two years, provided that three months' notice is given before the expiry of 18 months from date. The company will pay the city $5,000 a year, supply the city with 20 free telephones, and furnish house 'phones at $27 and business telephones at $45. Should the franchise be cancelled at the end of two years, the city will receive only $2,500 a year for that term.—*Montreal Gazette.*

Italy.—The official telegraph and telephone reports for the years 1899-1900, 1900-1, and 1901-2, have just been published in the *Journal Télégraphique*. It is stated that the establishment of the international telephone line between this country and France cost 700,000 fr. Special lines were also laid to effect direct communication with Switzerland.

It was found that iron wires in the mountainous districts were liable to frequent interruptions, and they were, therefore, replaced. Experiments are being carried on with new poles obtained from the Black Forest and Bavaria.

From 1899 to 1902, the system increased by 1,956 kilometres of line, and 10,377 of wire.

During the year 1901-2, 3,463 interruptions occurred to the railway telegraphs, and 3,939 to the Government lines. Of these, in the two services, 149 were due to broken poles; 966 were due to broken wires; 1,264 were due to broken insulators; 4,780 were due to contact, &c., and 243 were due to lightning.

The submarine cable service totalled 3,959,652 metres, and 13 interruptions were dealt with between 1899 and 1902.

140 new offices were opened in 1899-1900; 188 in 1900-1, and 156 in 1901-2, bringing the total offices open up to 6,234.

Government dispatches during the above three periods numbered 147,971, 325,419 and 260,688 respectively. The last figure, it is explained, equals one-fourth of the private telegraphic traffic, and is due to the improper use of telegraphs by officials for matters of a non-urgent character, which the Government is trying to counteract.

The number of telegrams of all kinds dealt with was 50,456,550 in 1900, 54,563,374 in 1901, and 56,847,580 in 1902.

Only about 1·2 per cent. of the inland traffic is paid for by adhesive stamps.

The numbers of telegrams per 1,000 inhabitants sent from towns were as follows:—Genoa, 876; Rome, 685; Milan, 653; Naples, 596; and Venice, 571. The international traffic during 1901-2 amounted to 2,486,805 telegrams, an increase over the previous year of 28,363.

The receipts of the telegraphic and telephonic services for 1899-1900 were 15,294,783 fr.; 1900-1, 16,023,604 fr.; and for 1901-2, 16,547,602 fr., showing increases of 683,515, 728,821, and 523,998 fr. respectively.

The expenses of the Postal and Telegraph service amounted to 62,354,783, 65,638,959, and 68,279,658 fr. respectively for the three periods under review, leaving profits of 15,251,540, 16,343,651, and 19,008,175 fr.

Faroe Islands.—The Great Northern Telegraph Co. notifies the laying of a cable to the Faroe Islands (Thorshavn). The cable was opened for traffic on the 1st inst., and the rate from any office in the United Kingdom is 5½d. per word. Telegrams to other places in the Faroe Islands will be sent by post from Thorshavn.

Japan.—The Japanese Administration announced the opening of the Tokio-Guam section of cable for public service on 1st inst.

Manchester.—The Watch Committee has concluded an arrangement with the General Post Office for the provision and maintenance of a new system of telephonic fire alarms in connection with the new central fire station in London Road. At this fire station there will be several switchboards and an up-to-date telephonic apparatus, 200 "nonpareil" fire alarm signal boxes being placed in the streets on iron pedestals. For an annual rental of £490 the General Post Office will provide a staff of specially-trained officers to maintain the installation. The charge for wire will be at the rate of £4 a mile, and if, as is thought probable, 150 miles of wiring be required, the annual rental for wire will be about £600.

Private Telephone Wires.—Mr. A. Williamson having asked the Postmaster-General if he could see his way to reconsider the scale of charges for private telephone and telegraph wires between the chief cities, so as to promote the trade of the country. Mr. S. Buxton replied that owing to the increasing congestion of the routes available for overhead lines between London and Liverpool and other large cities in the United Kingdom, it became evident some time ago that the provision of any considerable number of long private wires would involve a very large expenditure in the rearrangement of the existing telegraph system, and in the establishment of new routes, involving serious wayleave difficulties, and might impede the proper development of the public service. It was, therefore, necessary to adopt the present tariff, which was designed to secure some return of business. He was not prepared to provide double-wire telephone circuits for private use at lower rates; but he was considering a scheme under which telegraph as distinct from telephone circuits might be provided on moderate terms.

St. Petersburg.—A serious outbreak of fire occurred at the Telegraph Office on Saturday last, causing an interruption of communications between St. Petersburg and the provinces. The cable service to foreign countries was not affected.

South America.—The United River Plate Telephone Co. has commenced laying underground mains in Rosario.

Messrs. E. M. Coll & Co. have applied to the Argentine Congress for a concession for the laying and working of a submarine cable from the coast between Bahia Blanca and the River Plate, which would touch Tristan da Cunha, the Canaries, Cadiz and England.

Spain.—The Government has resolved to appoint a committee for the reform of the telegraphic administration, and has fixed a term of three months for the organisation of a new telephone service.

Street Telephone Kiosks.—A recommendation from the Works Committee to grant permission to the National Telephone Co. to erect nine kiosks in the borough of Paddington at a rental of £25 each was opposed at Tuesday's meeting of the B.C., and finally was withdrawn. Experience in Holborn has demonstrated the fact that the public show a marked preference for the kiosks as compared with the usual call offices.

Telegraphic Interruptions and Repairs:—

		Interrupted.	Repaired.
Cables.			
Trinidad-Demerara (No. 1.)		Aug. 26, 1901	
Dominica-Martinique		May 7, 1902	
St. Lucia-Martinique		May 7, 1902	
Reissa-Issa (Yemen) Camaran		Oct. 22, 1902	
Cayenne-Pinheiro		Aug. 18, 1902	
Port Arthur-Chifu (Closed)		Mar. 7, 1904	
Tarifa-Tangier		Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz		July 12, 1906	
Bolamo-Bissao		July 24, 1906	
Curaçao-La Guayra / Curaçao-Coro	Closed	Jan. 11, 1906	
Landlines.			
Puerto-Barrios		Aug. 28, 1902	
Bachkale-Deliman		Feb. 12, 1906	
Bagdad-Bassorah		July 17, 1906	

Wireless Telegraphy.—It is reported by the *Morning Leader* that the German cruisers *Vineta* and *Muenchen* are on their way to the most northerly parts of the North Sea and to the Norwegian coasts in order to conduct wireless telegraph trials. The object of these is to ascertain from what distance communication can be kept up with the new wireless telegraph station at Norddeich, the most north-westerly point on the German mainland. The object which the German Admiralty has in view is to establish a system by means of which wireless telegraphic messages can be exchanged between points on the German coast and every part of the North Sea region.

The Secretary of State for the Colonies has authorised the Crown agents to invite tenders for wireless stations in the West Indies.

GREENOCK ELECTRICITY WORKS EXTENSIONS.

The town of Greenock has claimed consideration for many years as one of the most important seaports in the country, and a busy centre in shipbuilding and engineering. It was only to be expected that in such a town the question of a supply of electricity would soon come to the front, and as far back as 1883 a provisional order was obtained by the municipality for the supply of electricity within a small area. Greenock possessing the questionable distinction of being the wettest town in Great Britain, it was but natural that the Town Council of that period should have turned its attention to water power, and the first installation, which was erected in the latter part of 1883, consisted of one 40-H.P. water turbine driving four generators of the old Gramme ring type. A few public lamps were installed in order to show the possibilities of the new illuminant, but the only important customer appears to have been a neighbouring sugar refinery.

The supply pressure was 100 volts, and as there were no other large consumers near the station, the cost of distribution was prohibitive; and after a considerable amount of money had been spent, the station was shut down. Latterly the School Board has utilised it as a laboratory, and the machines after being rewound are now used to generate current for class purposes.

After this somewhat discouraging experience, the Council left electric lighting severely alone for a long time, but in 1897, when a company proposed to apply for powers to supply electricity within the burgh, the Council was obliged either to start a supply business of its own, or to hand over its powers to the company. Mr. S. E. Fedden—now city electrical engineer of Sheffield—was appointed electrical engineer, and a scheme was drawn up estimated to cost £35,000. This was immediately put in hand, and on November 30th, 1899, public supply commenced.

A description of the station appeared in the Electrical Review of March 30th, 1900, and it is only necessary to state here that the installation consisted of two B. and W. boilers, three steam sets of a total capacity of 400 KW. and a storage battery. The mains were laid partly on the solid system and partly in Callender-Webber conduits.

The British Electric Traction Co. at this time acquired a controlling interest in the old tramway company, which applied to the Council for a renewal of the lease which was about to expire; the lease was renewed on condition that the energy necessary for working the tramways should be purchased from the Corporation—the minimum guarantee being 500,000 units per annum at 1½d. per unit. The requirements of the Tramways Co. necessitated an extension of plant, and in 1901 two additional generating sets, each of 150 KW. capacity, were installed under the supervision of Mr. Nelson, who had succeeded Mr. Fedden as burgh electrical engineer. The supply to the tramways commenced in October, 1901, the number of cars in operation being 30, and the length of single track 13 miles. A further addition to the plant was soon made in the form of a 300-KW. Belliss-Silvertown generator and two Babcock & Wilcox boilers.

In January of 1903 the present engineer, Mr. J. A. Robertson, was appointed in succession to Mr. Nelson. A dispute with the Tramways Co. regarding the price to be paid for energy used in excess of the minimum guarantee was referred to the Board of Trade for arbitration at this period, and the arbiter, who happened to be a lawyer, quite unacquainted with technical matters, reduced the price of the excess energy to seven-tenths of a penny per unit, bringing down the average for the whole supply to practically 1d. per unit. As the award was retrospective, the immediate result was a serious deficit in the financial returns of the undertaking, and remembering the result of the early experiment, some members of the Council began to be alarmed. Fortunately, an enlightened policy was adopted. Prices were reduced for both lighting and power purposes; condensing plant was brought into operation to reduce the works costs, and a system of "free wiring" and hiring-out of motors was inaugurated to encourage and popularise the use of electricity. The results soon justified the policy adopted. A brisk demand for power arose from the local shipbuilders and engineers, and the lighting business made steady headway, with the result that the output of the station doubled itself in a very short time. The motors installed rose from 670 H.P. at the end of 1903 to 3,100 H.P. in 1905, and the equivalent number of 8-C.P. lamps installed for all purposes (exclusive of tramways) jumped from 42,000 to 85,000 during the same period. Notwithstanding the reduced prices, the undertaking was able last year to show a net surplus of £1,600 after paying interest and sinking fund charges, and although the result of the past year's working is not yet to hand, it is confidently anticipated that the results will be equal to, if not better than, those of the preceding year.

The buildings for the Hunter Place generating station are situated near the centre of the town, and consist of a boiler house, engine room and three battery rooms.

In the boiler house are six Babcock & Wilcox boilers, each capable of evaporating 7,500 lb. of water per hour at a pressure of 200 lb. per sq. in.; they are all fitted with superheaters and chain-grate stokers, driven by a 5-H.P. Silvertown motor. A Green economiser of 256 tubes has been installed, with a 2-H.P. motor to drive the scrapers.

For the feed-water supply there are two Weir pumps, each capable of delivering 1,500 gallons per hour against the full boiler pressure, and a steam-driven Worthington pump. Just lately, however, a motor-driven Worthington pump has been installed, which is capable of delivering 6,500 gallons of water per hour. This pump is driven by a 25-H.P. motor through gear wheels, and is the one that is generally used for feeding purposes.

All the pumps draw from a large tank fed from the town mains, into which all the drainage from steam traps, &c., is led; a water meter measures all the feed water used.

A feed-water purifier by the Harris Patent Feed Water Filter, Ltd., installed six months ago, has given excellent results, removing every trace of free and emulsified oil. The action being a chemical one, the solid re-agents are charged into the apparatus, and are delivered automatically, in the form of solutions of a given specific gravity, without any mixing, weighing, or measuring; the water after treatment is passed through filter tanks, where the precipitate is removed and the water rendered absolutely pure.

The cost of treatment works out at just under ⅜d. per 1,000 gallons for re-agents, and the amount of attention required is about half an hour per day of one man's time. The quantity of water used in washing out is about 1 per cent. of the total quantity of water purified.

The plant installed in the engine room consists of two 400-KW. Belliss-Westinghouse sets, which are shown in a separate illustration; two 300-KW. Belliss-Silvertown sets; two 150-KW. Belliss-Silvertown sets; one 200-KW. and one 100-KW. steam balancers, both Belliss-Silvertown, making a total plant capacity of 2,000 KW.

In addition to the above, there are two battery-charging boosters, each capable of generating 120 amperes at 50 to 150 volts, and driven by a motor taking 75 amperes at 300 volts, running at 750 r.p.m.; these machines are ranged in line with half-couplings, which normally run clear, but can be bolted together with a distance piece between them, and when so coupled, the combination becomes a booster-balancer.

A 15-ton crane, by Messrs. Carrick & Ritchie, traverses the engine room.

The new switchboard is by Messrs. Kelvin & White, and was put down in 1904. It runs along the south side of the engine room on a platform 8 ft. high, and presents a very handsome appearance. The ornamental ironwork about the switchboard was made by Messrs. the Lion Foundry Company.

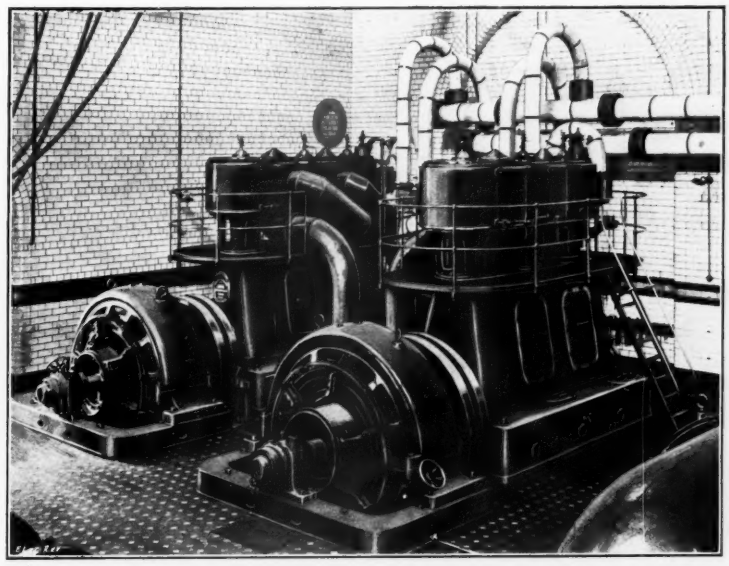
Below the floor of the switchboard are fixed the shunt regulating resistances, which are operated by handwheels attached to upright rods in front of the panels. The generating sets can be plugged on to either the traction or

lighting bus-bars, and a sliding panel in front makes it impossible accidentally to connect with both at once.

There are two sets of lighting bus-bars, and each feeder is provided with a change-over switch, enabling it to be put on either bar.

The traction feeders are not only protected by separate cut-outs, but also there is a large cut-out which can isolate the entire tramway system. A time-element instrument is provided, however, which allows a few seconds to elapse after the maximum current has been reached before the cut-out acts, and this has been found of great advantage.

All the engines exhaust into a main exhaust pipe, which runs under the floor of the engine room. A surface condenser capable of dealing with all the exhaust steam is placed in a pit in front of the switchboard, an Edwards three-throw motor-driven air pump being used in conjunction with the condenser. Two exhausts to atmosphere are also provided.



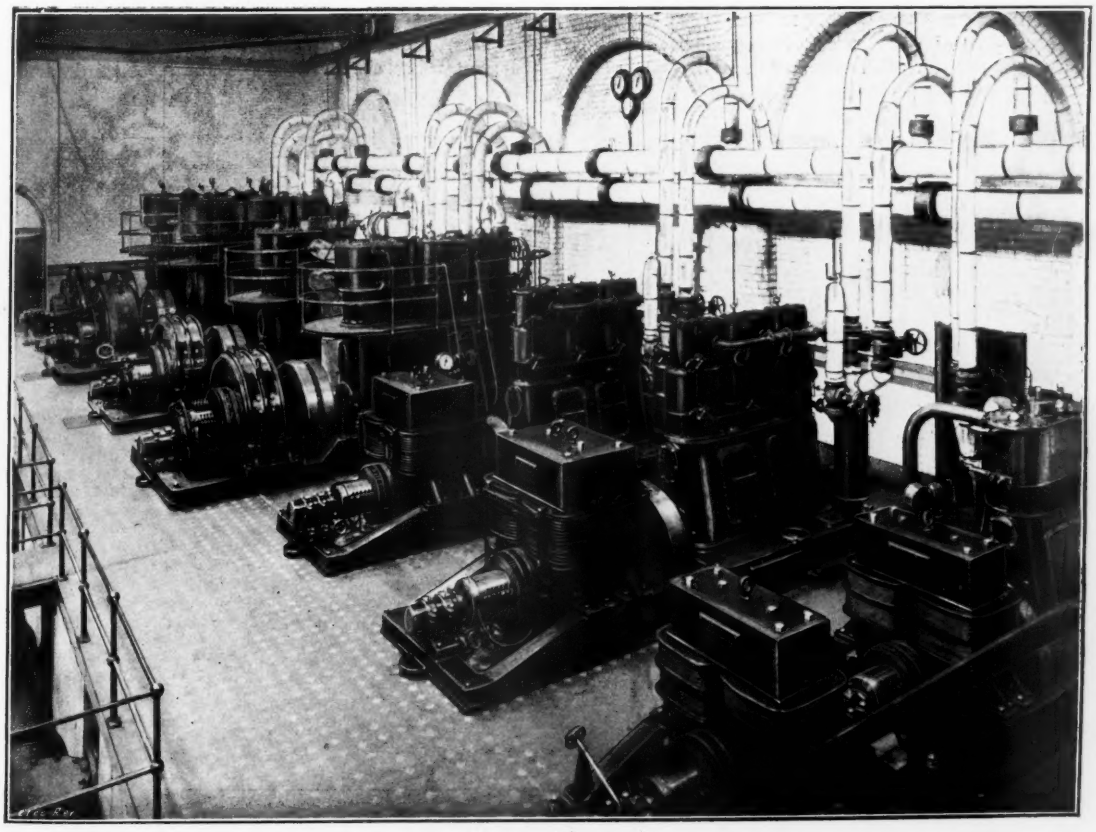
Belliss-Westinghouse 400-kw. Steam Dynamos.

A lighting battery by the Tudor Co., consisting of 304 cells in two tiers, occupies the ground floor of the battery rooms; 50 cells on each side of the middle wire are connected with the regulating switches. Its normal capacity is 400 kw.-hours, and it has a maximum discharge rate of 280 amperes. A traction battery by the Chloride Electric Storage Co. occupies the two floors above: this battery consists of 260 cells having a capacity of 450 kw.-hours, and a maximum discharge rate of 460 amperes.

An "Entz" reversible booster works in conjunction with this battery, and has given remarkable results during the eight months that it has been in use.

Although the traction load was only about three-eighths of the total output of the station when the battery and booster were started up, the coal consumption immediately dropped from 6½ lb. to 5 lb. per unit generated. The average traction load is only about 360 amperes, but at times it rises to 1,000 amperes, so that without a battery and booster it was necessary to run a generating set of 300 kw. to supply an average load much under its capacity, while at times 500 kw. was required for short periods.

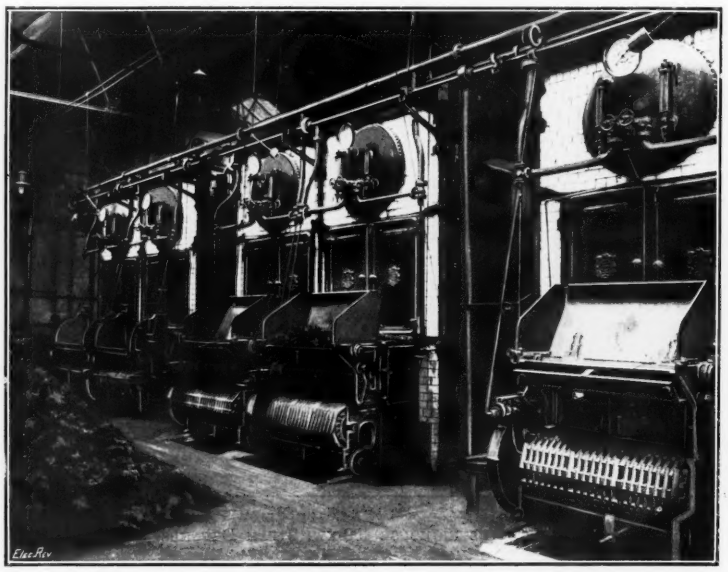
With the battery and booster a 300-kw. set was found too large, and as there was no 200-kw. generator, it was



Greenock Electricity Works: General View of Engine Room.

found that using the 300-KW. set one day and the 150-KW. set the next met all the demands made by the tramway system.

The "Entz" booster consists of two D.C. machines coupled together, with a separate chain-driven exciter, the whole being mounted on one bed-plate. The field winding of the booster consists of one coil only, separately excited from the exciter; the exciter field is excited through a carbon regulator which receives its energy from a few cells of the storage battery. This carbon regulator is simply a variable resistance actuated on the Wheatstone bridge principle, the variation being effected by increasing or diminishing the pressure on the carbon columns. A solenoid actuating the armature of the carbon regulator is placed in series with the generator current. A rheostat is placed in series with each leg of the carbon regulator, and enables the regulation to be adjusted in either direction.

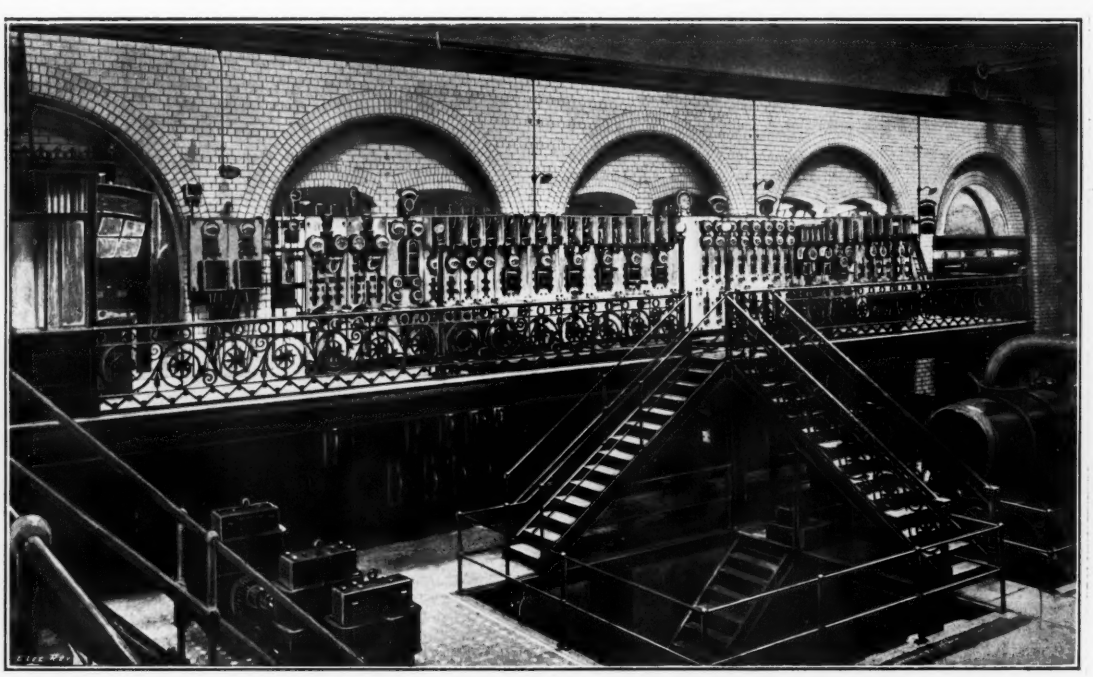


Babcock & Wilcox Boilers.

As the voltages of the two sections of the battery are almost the same, the direction and amount of current in the exciter field depends on the relative resistances of the carbon piles, and this varies inversely with the pressure. In starting up the controlling spring is adjusted, so that with a given current in the series coils there is no pressure on either of the carbon piles. After the carbons have warmed up no further adjustments of any kind are necessary, and the booster works quite automatically with the load fluctuating between 100 and 1,000 amperes, the current on the generator being kept practically constant. A view of the switchboard used with this booster is given on the opposite page. The current is distributed by means of $5\frac{1}{4}$ miles of Callender single-core bitumen cable laid solid.

There are about 12 miles of streets supplied with mains, principally Glover and Callender cables, laid solid, and also drawn into Callender-Webber casing. The pressures of supply are 250 volts for lighting, 250 and 500 volts for power and 550 volts for traction.

The prices for energy are:—For lighting 4d. flat, or 6d. and $1\frac{1}{2}$d. on the maximum demand system; for public lighting 4d. and $1\frac{1}{2}$d., with two-rate meters; and for power a sliding scale from $2\frac{1}{2}$d. to 1d., or a maximum demand rate of 3d. and 1d. In order to prevent the use of inferior lamps, the Electricity Department supplies consumers with new lamps of English make at 1s. each, up to 25 C.P., and sends an inspector, when desired, to advise consumers as to the best means of using the light to advantage. The department also enters into annual contracts to inspect and renew consumers' lamps periodically at a fixed charge.



Main Switchboard.

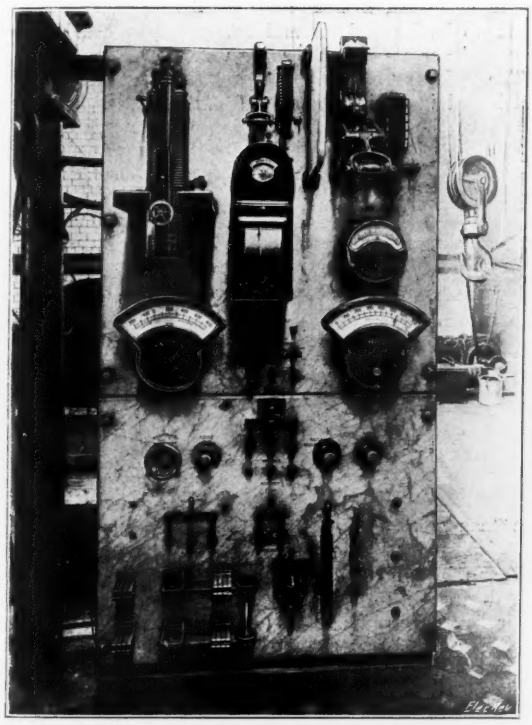
Owing to the rapid increase of the demand for electricity a new power station is in course of erection, and will begin with two generators of a total capacity of 1,500 KW. Mr. J. A. Robertson, M.I.E.E., is both resident engineer and consulting engineer for the new work.

THE BOLTON DISTRIBUTION SYSTEMS.

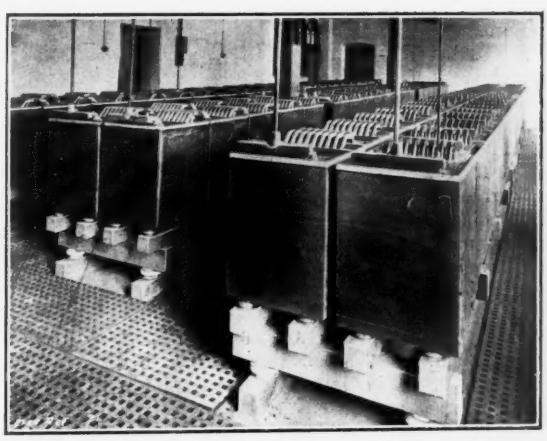
Having from time to time described the original generating plant of the Bolton Corporation and its extensions in the Electrical Review, we propose in this article to confine our attention to the distribution system, dealing at some length with one or two novel features.

The original plant was laid down for distributing alternating current with a periodicity of 83, at a pressure of 2,000 volts, to sub-stations in the centre of the borough and the most thickly-populated districts. In the case of supply in the scattered districts, house transformers were used. Distribution from the sub-stations was effected on the three-wire system at a pressure of 100 volts on each side of the system by means of three-core lead-covered and armoured cables.

During the latter part of the year 1899, the existing tramway routes, together with several new routes, were equipped for electric traction, and on January 1st, 1900, all horse-cars were withdrawn from the Corporation routes. The service of the electric tramways necessitated the installation of a large system of underground feeders to the overhead work, these feeders being all lead-covered single cables drawn into earthenware pipes. The British Insulated and Helsby Cables, Ltd. (then the British Insulated Wire Co.), supplied all the material, and carried out all the work in connection with the laying and connecting up of the tramway feeder system.



Greenock: "Entz" Booster Switchboard.



Tudor Battery at Greenock (see p. 180).

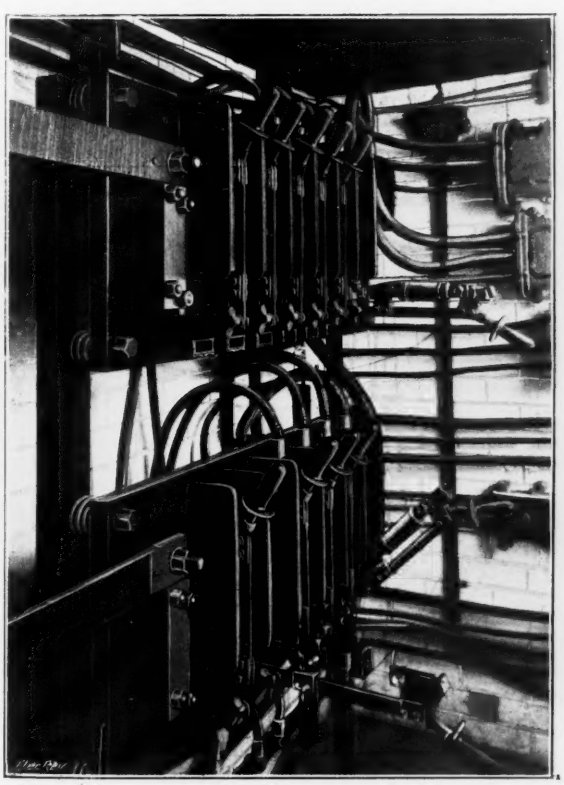


Fig. 1.

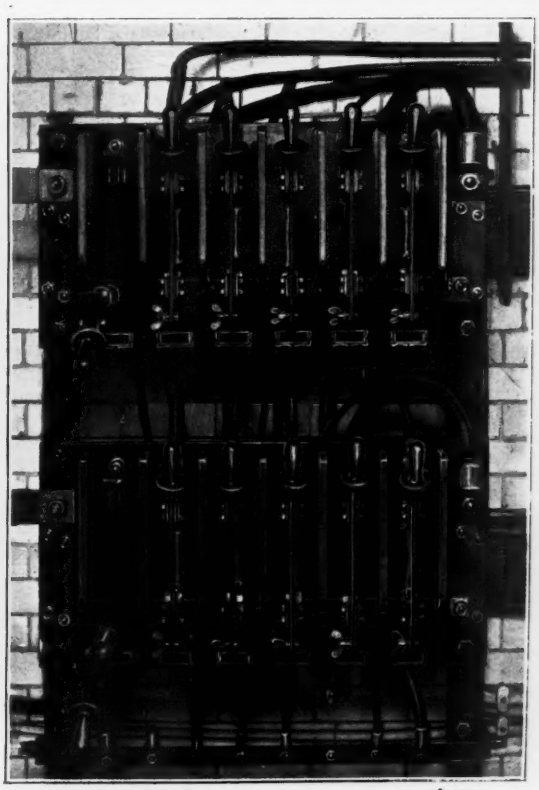


Fig. 2.

Combined Switch and Fuse Panels in Bolton Sub-Stations.

In the summer of 1900 the distribution in part of the centre of the borough was changed over to a continuous current three-wire system at 230 and 460 volts pressure. This system has gradually been extended, until at the present time practically all the consumers within one mile radius of the generating station are connected to it. The aggregate horse-power of the motors coupled to the direct-current mains now amounts to over 3,500.

The single-phase system has in the meantime been extended to all the outlying residential districts, the transformers from the sub-stations in the centre of the town having been transferred to small sub-stations in the out-districts; and the distribution is effected principally through twin cables at 200 volts pressure.

The old underground sub-stations in the centre of the town were found so admirably suited for continuous-current feeding points, that underground chambers have been built for additional feeding points in preference to feeder pillars or boxes. These chambers, of which there are nine, vary in size from 5 ft. × 6 ft. 6 in. × 6 ft. to 6 ft. × 13 ft. 6 in. × 7 ft. 6 in.; they are built at the junctions of main streets where feeder pillars would be considered an eyesore and an obstruction to traffic. The sizes of feeders in use are ·5 and ·8 in. triple-concentric (laid solid in earthenware troughs), and 1·3 in. B.I. and H.C. singles drawn into earthenware pipes; the sizes of the distributors are ·0625, ·125 in. three-core armoured cable laid direct, and ·125, ·25 and ·5 in. singles laid solid in wood troughing, the neutral wires having approximately half the section of the outers. The three-core distributors were originally in use on the alternating-current system, and have given very little trouble with the increase of pressure.

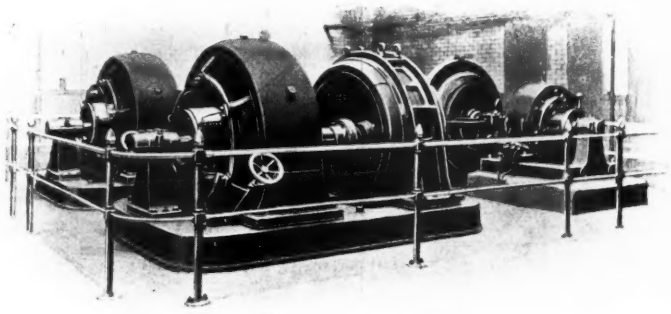


Fig. 3.—B.T.-H. Motor-Generators.

Fig. 4.—B.I. and H.C. Switch Fuse.

Each feeder supplies a practically distinct network, as in only two cases are feeders connected in parallel in order to equalise the pressure on the longest distributors, and then they are only coupled through light fuses in straight-through B.I. & H.C. fuse boxes.

Disconnecting boxes are liberally used in order that faults may be easily localised, and lengths of distributors changed from one feeder to another when desired. As the distributors are fused only at the feeding chambers and are not interconnected, the least possible inconvenience is caused by a breakdown with this system, only the distributor on which the fault occurs being affected.

Separate switches and fuses were at one time used in these feeding chambers, but the break of the switch and fuse was found to be insufficient, and longer breaks could not in all cases be arranged in the space available.

The ordinary type of plug switch fuse was then adopted, and is still in use in one or two feeding chambers; but this type was found to have a number of objectionable features, the chief of these being that:—(1) Probably owing to the expansion of the metal parts due to the heat from the fuse, the porcelain handles have been found to crack, and naturally come to pieces when the fuse operates or the arrangement is used as a switch; (2) they are often fractured by the average jointer or by a short on the mains; (3) most jointers have been found strongly to object to a fuse blowing in the palm of their hand, or an inch or two from their knuckles, when replacing a fuse with a short on the distributor; (4) under these circumstances the switch fuse is not always accurately replaced, the blades fouling instead of entering the contacts; the effect can then be better imagined than described.

A combined switch and fuse was designed and protected to overcome these objections, whilst taking far less room than a separate switch and fuse. This type has been manufactured and supplied by the B.I. & H.C. for several of the feeding chambers in Bolton, and has been found in every way satisfactory, especially to the men who have to operate it.

Some of these fuses are shown in the accompanying illustrations. Fig. 1 (p. 181) shows two of four 6-way panels fixed in Churchgate chamber: fig. 2 shows two of four in Balmoral chamber, and fig. 5 a larger view of one of these panels. Referring to the latter, it will be seen that they are of very simple construction, consisting of a metal lever (in these cases wrought-iron) secured at one end by a wing-nut (in order that the lever may be easily removed if required), and fitted with a suitable handle at or near the other end. The contact blades are firmly fixed to, but well insulated from, this lever, a fuse preferably of the enclosed type being fixed in the usual way between these blades. Carbon breaks are also fitted in order to prevent damage to the contacts when

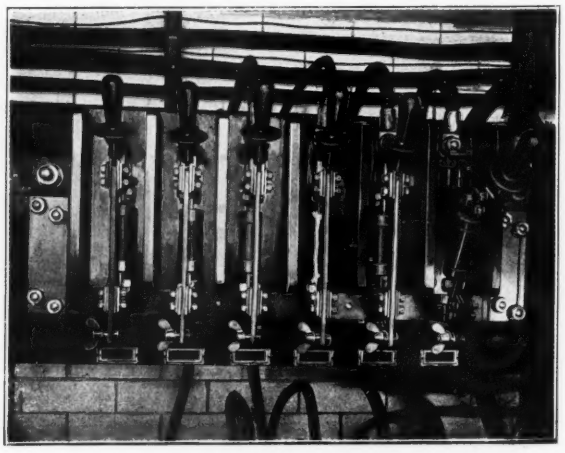


Fig. 5. Switch-Fuse Panel.

opening circuits on load; in fact, the arrangement now in use has all the advantages of a good knife switch in combination with those of a fuse.

Fig. 4 shows a smaller switch fuse of slightly different construction; this is fitted in a portable sheet-iron case, and is used to localise roughly a fault on the distributors. If a fault comes on sufficient to blow the fuse in the chamber, the links are first removed in the disconnecting boxes on the faulty section, and the switch fuse is closed in the chamber. If this fuse does not blow it shows that the fault is not on the first section; the portable switch fuse is then put in circuit in place of the link in the first disconnecting box and closed. If the fuse does not blow, the link is replaced, and the operation is repeated at the next box and so on, until the faulty section is found; the fault is then accurately localised by a method similar to that described in the "Correspondence" columns of our issue of March 17th, 1905.

The records, &c., in connection with the distribution system are kept chiefly on the card system, in a very similar manner to that described in our issue of March 23rd, 1906, on pages 487 to 489.

We may mention that a three-phase 50-cycle 6,000-volt system has recently been laid down—in the first instance, to supply power to several cotton mills belonging to the Fine Cotton Spinners' and Doublers' Association, Ltd., and ultimately to supply power and light to the outlying districts and large consumers. Two B.T.-H. 300-KW. 460 to 6,600-volt Y-connected motor-alternators, shown in fig. 3, have been installed; steam-driven sets are also being erected.

The feeders, of ·075 in. section, lead-covered with B. of T. earth shield, have been supplied by the B.I. & H.C., Ltd., and laid on the solid system in duplicate.

The switchboard for controlling these motor-alternators and feeders has been supplied and erected by the Key Engineering Co.

The sub-station switchgear and the transformers for the mills have been supplied and erected by the British Westinghouse Co. The transformers are oil-cooled, with delta-connected primary and star-connteced secondary, wound for 400 volts between conductors for power, and approximately 230 volts to the neutral point for lighting on the secondary side.

Our thanks are due to Mr. Arthur A. Day, A.M.I.C.E., M.I.E.E., the borough electrical engineer and tramways manager, for permission to publish this article; also to his chief assistant, Mr. Hornby, and to the British Insulated and Helsby Cables, Ltd., for information and illustrations used in connection therewith.

CONTRACTS OPEN and CLOSED.

OPEN.

Bolton.—August 9th. Two Lancashire boilers for the electricity department. See "Official Notices" July 20th.

Brentford.—August 8th. Wiring, telephones and bells, for the Brentford Union new buildings erecting at Isleworth. Architect, W. H. Ward, Paradise Street, Birmingham.

Coventry.—August 8th. High-tension twin-concentric cable for the Corporation. See "Official Notices" to-day.

Dudley.—August 13th. Feeder and distributor cables for the Electricity Department. See "Official Notices" July 27th.

Gloucester.—August 9th. Stores for the Light Railways Committee. See "Official Notices" July 27th.

Greenock.—August 7th. Coal, engine room stores, and electricity meters for the electricity department. See "Official Notices" July 27th.

Leeds.—August 15th. Steam and other piping for the electricity department. See "Official Notices" July 20th.

London.—The B.C. of Paddington is about to invite tenders from selected firms for installing telephones in the Town Hall.

Manchester.—August 6th. Electric tramcar bodies, car equipments and trucks for the Tramways Committee. Mr. J. M. M'Elroy, general manager.

Portsmouth.—August 6th. Welsh steam coal for the Tramways Committee. See "Official Notices" July 27th.

Spain.—The municipal authorities of Cardona (province of Barcelona) have just invited tenders for the concession for the electric lighting of the town.

Stockport.—August 11th. Water-tube boiler, superheater and stoker, for the electricity works. See "Official Notices" July 27th.

Stoke-upon-Trent.—August 4th. Water-tube boiler for the Electricity Committee. See "Official Notices" July 20th.

Walthamstow.—The Board of Trade having sanctioned the provision of additional loops on the tramway route, tenders are to be invited for carrying out the work.

CLOSED.

Bolton.—The Corporation has accepted the tender of Adams Manufacturing Co., Ltd., for the supply of motor starting rheostats for one year up to March 31st next.

Chelmsford.—The Joint Hospital Board has accepted the tender of Mr. F. H. Dennis, electrical engineer, of Chelmsford, for the installation of telephones at the hospital.

France.—The French Post Office and Telegraph authorities in Paris have just given out contracts as follows:—Les Forges de Franche-Comté, of Besançon, 188 tons of galvanised iron wire 4 mm. dia., at 390 fr. per ton; and La Compagnie Française du Bimetal, Paris, 60 tons of bronze wire, 2 mm. dia., at 2,190 fr. per ton, and 75 tons ditto, at 2,105 fr. per ton.

Halifax.—The Electricity Committee has accepted the tender of the Chloride Electric Storage Co., Ltd., for 24 C.W.S. type storage cells for the sum of £176.

Hull.—The E.L. Committee of the T.C. has accepted the tender of Thos. Parker, Ltd, for the supply of two transformers, at £1,642, and that of the Lahmeyer Electrical Co., Ltd., for one transformer, at £1,536 10s.

King's Norton and Northfield.—The U.D.C. has accepted the tender of Messrs. Wm. Underwood & Brother, Dukinfield, for the construction of the permanent way of the Moseley and King's Heath tramways, and the extension to Alcester Lanes End, at £29,462, and that of the Brush Electrical Engineering Co., Ltd., for the overhead equipment, at £4,115.

Middlesex.—The Middlesex County Council, on July 26th, received the following tenders for the construction of railway No. 1:—

GREEN LANES, WOOD GREEN, AND SOUTHGATE, ORDER, 1903, CONTRACT No. 17.

W. Dobson (Edinburgh)	£63,315	Wm. Griffiths & Co.	£69,811
Dick, Kerr & Co. (accepted)	65,910	Wm. Underwood & Co.	70,470
Ford, Clift	65,910	J. A. Ewart	72,123
T. Adams	67,394	G. Law	74,645
Zadig & Co.	67,890	T. Turner	76,702
J. Mowlem & Co.	68,300	Muirhead & Co.	77,434
G. Wimpey & Co.	68,458	R. W. Blackwell & Co.	84,079
British Elec. Equipment Co.	69,155	Brush Elec. Engineering Co.	124,893

The County Engineer's estimate of the cost was £68,411 11s. 9d.

The construction of railways Nos. 1 and 2 under the Waltham Cross and Enfield Order, 1906, was placed in the hands of Messrs. Dick, Kerr & Co. at the same prices and under the same schedule at which they constructed the section of railway No. 15 Order, 1903, from the Edgware Road to the Willesden Green Railway Station. Messrs. Dick, Kerr are to be requested to allow their offer for the construction of railway No. 4, under the Waltham Cross and Enfield Order, to remain open for a further period.

The construction of part of railway No. 7 from the termination of railway No. 2 in the High Road, Southgate, up to the bridge north of New Southgate Station, has been placed in the hands of Messrs. Wimpey & Co. at an advance of 7½ per cent. on the schedule of prices at which they are constructing railway No. 2, Order 1901.

Walthamstow.—The U.D.C. has accepted the following tenders:—

Callender's Cable Co., 12 feeder pillars	£17 each.	Oliver & Co., 8 spare arc lamps	£33
		Reavell & Co., air compressor	90

London.—Islington.—The Lighting Committee of the B.C. has received the following tenders :—

250 End Sealing Boxes for Concentric Cable.

	Each. s. d.		Each. s. d.
Brit. Insulated & Helsby Cables Co. (provisionally accepted) ..	8 3	Sowden & Sons	12 0
Berry, Skinner & Co.	8 3	Glover & Co.	14 0
Rumney & Rumney	8 3	W. Lucy & Co.	14 6
J. A. Cross	10 0	Imperial Construction Co. ..	17 0
Westminster Engineering Co...	10 6	Callender's Cable Co.	15 10
Universal Electrical Co. ..	10 6	Howard Davies	15 6
Moy & Co.	11 0	Reason Manufacturing Co. ..	17 6
		Henley's Telegraph Works Co.	17 6

The following tenders were received for 230 isolating switches :—

	Each. s. d.		Each. s. d.
Univer. Elec. & Manufac. Co. (provisionally accepted) ..	11 0	E. Spagnoletti	15 0
Ernest F. Moy	12 0	Drake & Gorham	18 9
General Electric Co.	12 3	Union Electric Co.	19 0
Veritys, Ltd.	12 9	Johnson & Phillips	22 3
Oliver & Co.	14 0	Crompton & Co.	27 0
Reason Manufacturing Co. ..	14 6	Brush Electrical Co.	29 0

The following tenders were received for 5,000 yards of troughing and 13,500 brick covers :—

Leeds Fireclay Co. (provisionally accepted)	£112 0 0	J. Knowles & Co.	£157 0 0
Doulton & Co.	121 0 0	Albion Clay Co...	164 0 0

Stepney.—The B.C. has received the following tenders for the annual supply of meter cases :—

W. Badger (accepted)	£104	Buck & Hickman	£134
J. & W. Shale..	119		

An order has been placed by the Stepney Borough Council with Babcock & Wilcox, Ltd., for one steel coal bunker for the generating station, at £265.

Maidstone.—The T.C. received the following tenders for the supply of condensing plant for the electricity works :—

Mirlees Watson & Co. (accepted)	£977 0	Allen & Son	£1,232 10
Davey, Paxman & Co. ..	1,322 10	Babcock & Wilcox	1,100 0
		G. and J. Weir	1,080 0

Rochdale.—The Rochdale Electric Co., Shawclough, have secured the contract for the electric lighting of the new Crest Mill. They have also in hand similar contracts for the Clover and the Croft Mills. The dynamos and motors, which will aggregate over 500 H.P., will all be made at the works at Shawclough.

Woolwich.—The B.C. has accepted the tender of the Corporation Electricity Committee for installing the electric light at the Plumstead Baths and Washhouses, at £678.

NOTES.

An Attempt at Corruption.—We have received, and reproduce below, a copy of a letter addressed by a firm of boiler-makers to Messrs. Preece & Cardew, who naturally returned their tender unopened :—

"Messrs. Preece & Cardew, Westminster.

"Gentlemen,—With reference to my tender of this date for the boilers, &c., for the Shanghai Municipal Council, I beg to state that I do not know what other makers' prices for water-tube boilers are. I am of opinion, however, that my water-tube boilers can be made and sold at prices at least 5 per cent. less than what Messrs. Babcock and Wilcox will charge, but as I have no desire to cut prices and undersell Messrs. Babcock & Wilcox, the price I have quoted for the boilers, &c., amounting to £——, carries 5 per cent. for you.

"Yours faithfully, ————."

This barefaced and impudent attempt to buy preference hardly needs comment. We trust, however—not without misgiving—that it constitutes an exception.

Educational Notes.—University of Liverpool.—The 1906-7 session commences October 9th. Prof. Watkinson occupies the Chair of Engineering and Prof. Marchant that of Electrotechnics. Municipal electrical engineering is in the charge of Associate Prof. A. Bromley Holmes.

University of Manchester.—The session commences on October 2nd. A special course in electrical engineering has been arranged, leading to a certificate, and the electrical engineering training can also be taken as part of the course for the B.Sc. degree. Professor of electrical engineering, A. Schwartz; lecturer in electrotechnics, Dr. R. Beattie.

Institution and Lecture Notes.—On Friday last in the Theatre of the Royal Dublin Society House, Prof. J. A. M'Clelland delivered the second of his lectures on "Modern Conceptions of Electricity" before a numerous audience.

Electric Shock Fatality.—According to the *Morning Post* an electrician named William Holmes, 22 years of age, was killed by a "live wire" on Monday afternoon at the Airedale Foundry, Hunslet, Leeds. He was engaged in connecting up a motor when he slipped, and in trying to save himself put his hand on the wire.

Sentence on "Professor" Richard.—"Professor" A. E. Richard, who has been making a very good thing out of the electrical quackery business for some years, recently came up at Wolverhampton on charges of having obtained moneys from certain persons whom he had "professed" to be able to cure of their diseases and complaints by electrical treatment. It will be remembered that the police court proceedings lasted over a considerable period, a great deal of the evidence being given by those who had been gulled, other witnesses coming forward to testify to marvellous curves. The matter was referred to the Stafford Assizes, where charges on 17 counts were preferred against Richard. Some of the evidence given at the trial was amusing, especially that called in prisoner's defence. A Mrs. Cranston, of Bournemouth, had spent £2,000 upon doctor's without deriving any benefit, but about 1894 Richard quite cured her by his electrical treatment. He was an honoured and welcome guest at her house in consequence. She had written a letter in endearing terms to him, and Richard had invested £5,000 in her husband's company (Cranston's Tea Rooms, Ltd.). Mr. Cranston, out of gratitude, stood bail for £1,000 for the "professor," and advanced £2,200 for his defence. The jury found prisoner guilty, and previous convictions having been proved against him, he was sentenced to twelve months' imprisonment without hard labour.

The Inventor.—One, of the name of John Jones, writes to us as follows :—

"I am an inventor by nature and by profession—nowadays profession is nine points of success—and I am capable of inventing anything from a collar stud to a cannon, and beyond. Whether all my inventions have been what the world calls successful is another matter. After all, what does the world know about these things half the time?

"Let it suffice that, to the true inventor, the knowledge that he has invented, the sight of his name—I, John Jones, of Jonesville, in the County of Joneshire, &c.—on the document issued as letters patent by a mysterious, but none the less magnificent comptroller, is reward enough, even if no return for money spent is obtainable.

"Then there is the joy of drafting, and getting printed, and distributing broadcast to friends and enemies alike (alas, how many enemies the inventor has!) the descriptive pamphlet, illustrated, maybe, with home-made pictures; and again, how pleasant are the thrills which vibrate along one's spine as one reads in the local papers the title or the short description of some patent just granted to oneself. There is the name—how it stands out from the others, and how noticeable it must be to all the readers of the paper! Why, it is the very first name that I see. Surely it is pardonable that one whom the papers think worthy of mention in this prominent manner should believe that at least fame is his. Fortune!—what does one care for fortune, when Fame is in question? *That* is worth many patent fees!"

The Production of Nickel.—It is announced that the General Electro-Metallurgical Co., of Papenburg, proposes to establish in the immediate neighbourhood of the port of Emden, smelting plant for the nickel earth which the company works up, so that in future only the last process incidental to the production of nickel will have to be practised at Papenburg. The reasons which have induced the company to arrive at this decision are to be found in the fact that considerable expenses are incurred in the inland transport of the earth, which only contains 6 per cent. of nickel, and of which from three to four large shiploads are obtained from Australia every year.

Canals and Waterways.—The Royal Commission on Canals and Waterways resumed its sittings on July 31st last, at the Westminster Palace Hotel, Lord Shuttleworth presiding. Evidence was given by Mr. Rawlence, F.S.I., and Sir Wm. Tomlinson, former M.P. for Preston and President of the Mansion House Committee for the Improvement of Railways and Canals.

Appointments Vacant.—At a meeting of the Sunderland Corporation Electricity and Lighting Committee on 27th ult., it was agreed to recommend the Council to advertise for a successor to Mr. J. F. C. Snell, the electrical engineer, whose agreement with the Corporation will shortly terminate. Mains superintendent for Barrow-in-Furness (£135); shift engineer for Sheffield tramway power station (£130); charge electrical engineer for East Sussex County Asylum.

Electrolytic Corrosion of Structural Steel.—Engineers have commented publicly on the electrolytic corrosion of structural steel, particularly those parts known as "grillage beams," supporting the columns and base parts, which are either in the ground or surrounded by concrete and partly above the ground, with a view to determining at which of the poles corrosion occurs, and whether one pole is more active than the other. To clear this up once for all, Dr. M. Toch has made a series of interesting experiments, imitating on a small scale the conditions to which structural steel is exposed, and the results show conclusively that rusting takes place at the anode only, the cathode protecting the iron work quite effectually. The alkaline nature of concrete offers no resistance whatever to the action set up by stray currents, and what is of vital importance in constructions of all kinds is that the accumulation of rust at the anode is sufficient to crack the hardened cement base. The best protection in such cases is a coat of insulating paint on the steel, which must form a good bond with the concrete.—(Amer. Electrochem. Soc. *Electro-chemical and Metallurgical Industry*, IV, No. 6.)

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—Mr. C. W. HARVEY DEW has resigned his position as an engineer-in-charge at the Shoreditch borough electricity works in order to take up a post as "station supervisor" under the Admiralty.

Luton T.C. has increased the salary of Mr. W. H. COOKE, electrical engineer, from £260 to £300 per annum.

Mr. B. SANKEY, chief assistant engineer at Mansfield, has been appointed borough electrical engineer at Whitehaven. There were 248 applicants.

Tramway Officials.—The Derby Corporation Tramways Committee has increased the salary of Mr. F. HARDING, tramway manager, from £225 to £275 per annum; and that of Mr. C. BEACH, car-shed superintendent, from £130 to £150.

Mr. CHARLES W. HILL, A.M.I.E.E., has been appointed to the position of chief assistant in the Birmingham Corporation Tramways Department.

General.—Mr. F. D. WARD (late master mechanic of the Underground Electric Railways Co. of London, Ltd.) was on Monday last presented with a gold albert and locket, suitably inscribed, on the occasion of his resignation. The presentation was entrusted to Mr. G. G. PORTER, superintendent of the Mill Hill Park car-sheds, who referred to the loss he and the men would personally sustain, and to the tact, ability and consideration for all his subordinates by which Mr. Ward was distinguished. It was beyond doubt due to his indomitable perseverance that the many difficulties which arose during the electrification of the District Railway, in the construction departments, had been overcome. Mr. Ward in his reply made special mention of Mr. Porter, who, he said, had been his faithful henchman right through the undertaking. Wherever he was he could only hope that he would have command of a staff equally as good, for he knew he could not get a better. Mrs. F. D. Ward was also the recipient of a gold and diamond brooch, as a mark of esteem and respect, this presentation being made by Mr. ALBANESE (superintendent of the Lillie Bridge car-sheds).

Mr. THOMAS RICHARDSON and Mr. MARMADUKE FURNESS have been appointed to fill vacancies on the board of Richardsons, Westgarth & Co., Ltd., caused by the deaths of Sir Thomas Richardson and Sir William Allan, M.P.

Mr. HENRY M. SAYERS, M.I.E.E., has removed from 36 to 39, Victoria Street, Westminster, S.W.

At Newport recently Mr. R. WILLIAMSON, local manager for the National Telephone Co., was presented by the staff with a silver kettle and stand, on the occasion of his promotion to Swansea.

Mr. E. C. GEDDES, who has lately, in his capacity of commercial agent, been energetically developing the North-Eastern Railway Industrial Redistribution schemes, has now been appointed deputy chief goods manager to that railway, but for the present he will not relinquish his duties as commercial agent.

Mr. W. VINCENT WAITE, of Beddgelert, North Wales, who has been acting as managing engineer for Messrs. Bruce Peebles & Co., Ltd., contractors for the scheme, has been the recipient of a handsome marble timepiece and a pair of bronze vases, subscribed for by members of his staff who have been engaged under him in the construction of the power house pipe line and transmission lines for the North Wales Power and Traction Co., Ltd.

Mr. C. A. BAKER has been appointed electric lighting engineer to the L.C.C., in succession to the late Mr. Gunyon.

Obituary.—Mr. HENRY, borough electrical and tramways engineer for the borough of Nelson, has died as the result of falling from a bicycle which he was riding in the neighbourhood of Hellifield. At the inquest in the Nelson Town Hall on Friday afternoon, it was stated that Mr. Henry left home about 1 o'clock on the previous Sunday on his bicycle, without saying where he was going. He was alone, and at about 3.30 p.m. a coachman discovered him lying unconscious in the roadway near Hellifield, and his machine a short distance away uninjured. The front wheel was turned round, and it was surmised from the track of the machine that the unfortunate gentleman had run over a little stone, which had deviated the course of the front wheel, and thrown him off the cycle. In returning a verdict of "Accidental death," the jury expressed their sympathy with the widow. Mr. Henry was an exceedingly capable official, and during his short reign in his last office, he had instituted many improvements for the better working of the tramways and the electrical department in general. Mr. Henry served part of his apprenticeship at an engineering works in India; he then entered the establishment of Messrs. Siemens Bros. & Co., Woolwich, where he continued to be employed for seven and a half years. He was with the Bradford Electricity Department for two years, subsequently accepting the post of chief assistant in the electrical works at Nelson, a position he held for four years, during which period the electric tramway system was instituted. From there he went to Radcliffe, where he was the electrical engineer to the Council till January last, when he succeeded Mr. Frazer as Nelson's electrical engineer.

CITY NOTES.

Central London Railway Co.

THE twenty-second ordinary general meeting of this company was held on Wednesday at the Holborn Restaurant, W.C., Sir Henry Oakley presiding.

In moving the adoption of the report and accounts (ELECTRICAL REVIEW, p. 142), the CHAIRMAN said that the receipts from all sources amounted to £180,225, showing a decrease of £5,600. The only item of expenditure he need refer to was the sum of £11,000, included in the £14,200 expended on capital account, which referred to certain work at the Post Office sub-station. It was absolutely necessary that there should be no liability of a breakdown on the line, and the money had been expended on extra machinery installed with the object of providing continuity of service. Electricity was a thing which seemed always to require duplicating, and it was probable that they would have to incur a further expenditure at Shepherd's Bush. They were working at that place very near their margin of power, and any failure of power would affect them very materially and commercially. He was not in a position to say exactly how much money would have to be expended on the work, but probably between £20,000 and £30,000, would be necessary to ensure that there should be no failure on the part of the machinery. As to the revenue, he had been asked how he could account for the reduction in the number of passengers carried. He could say that the traffic was constantly being watched, and he was satisfied that the backbone of that traffic was not affected. The total decrease was only 3 per cent., and half of that was taken from the Sunday traffic. At the Bank they booked 5,000,000 passengers, and there there had been a decrease of about 73,000. Very possibly, what decrease had occurred had been the result of the better conditions of their competitors. There had, for instance, been a decrease of the passengers at Notting Hill Gate. So long as the Metropolitan and District Railways kept up fares, their line carried more passengers, but as soon as those companies dropped the fares, the passengers fell off in numbers. They were, of course, mostly short-distance passengers who were going penny stages. He thought, however, that there was a gradual return of passengers taking place, and it was no doubt due to the fact that the passengers felt they could rely on the tube trains. With regard to expenditure, every effort was being made to effect a reduction. The sum of £92,000 was available for dividend, and it was proposed to pay 4 per cent. on the ordinary and preference shares. Before he concluded, he must refer to the item of rates and taxes, which was very heavy. The manner in which railway companies were assessed was most unfair; in the case of a business undertaking, it did not matter how large the profit was, the rates were not increased on that account, but in the case of a railway company the rates were based on the profits realised. If by industry a railway company earned a large profit, the local authorities could take their share of it, and it happened that in all the parishes through which their line passed, the rates stood very high. He hoped that something would be done to remedy the manner in which such companies were taxed. In conclusion, he referred to the exchange stations being made with the other tubes. At Oxford Circus they had agreed to have an exchange station with the Bakerloo line and the Charing Cross and Hampstead line, the expenses of the construction being equally divided between the two companies in each case. At Oxford Circus they were now exchanging from 1,500 to 2,000 passengers a day, and when the Bakerloo exchange at the Elephant and Castle was opened, he looked forward to a greatly increased traffic.

Lord RATHMORE seconded the motion, and it was carried.

Eastern Telegraph Co., Ltd.

SIR JOHN WOLFE BARRY (chairman) presided on Wednesday at Electra House, Finsbury Pavement, over the sixty-eighth half-yearly meeting of the above company.

The CHAIRMAN, in moving the adoption of the report, said that although the accounts did not show such a large net profit as those for the corresponding period to March 31st, 1905, the result of the half-year's working might be considered satisfactory. The gross income for the half-year amounted, in round figures, to £628,300, as against, for the corresponding period, £676,200, or a decrease of £47,900. The most important reductions were in the receipts from India, China and Japan, South Africa and Egypt. The decreases in the receipts from India and Egypt were principally due to the reduction of the tariff from 2s. 6d. to 2s. per word in the former case, and from 1s. 5d. to 1s. per word in the latter. These reductions only took effect from August 1st, 1905, and they were now consequently comparing a full six months at the reduced tariff with the half-year which was not affected by the alteration in rate. He was glad to say that the Indian traffic was, on the whole, showing an upward tendency, though, with fluctuations in the opposite direction, he was afraid it would take some considerable time before the "standard" figure was again reached. They were, in the half-year under review, comparing the revenue from traffic with China and Japan with the abnormal revenue earned on that traffic during the war between Japan and Russia, and naturally the cessation of hostilities had caused a considerable reduction in Government and Press traffic. From the progressive tendencies showing themselves in China, and the commercial activity which was bound to take place in Japan, they looked forward to a growth of commercial traffic with these countries. Although the traffic with Egypt had increased since the reduction of tariff in August last, it would take some considerable time before they were

able to earn the same revenue as they derived from that traffic before the reduction came into force. The reduction in the earnings from South Africa was caused entirely by the diminution in business. The traffic with Australia had shown a substantial improvement, and as the associated companies had continued to carry approximately the same proportion of the total traffic as they had done since the opening of the opposition Government Pacific Cable route, this company had participated in this increased business. It was satisfactory to note that the traffic exchanged with South America had for some time past shown considerable expansion, and the boards of the Eastern and Western Companies had decided to enlarge their cable-carrying capacity between Great Britain and St. Vincent. It had been decided to lay the new cables *vid* Fayal, in the Azores, not only opening a new route, but also enabling the Western Co. to effect a junction with the Commercial Cable Co. at Fayal for the more rapid interchange of traffic between North and South America. The Eastern Co. would lay the section between Porthcurnow and Fayal, and the Western Co. would lay that between Fayal and St. Vincent. The total ordinary expenditure for the half-year showed an increase of £5,300 when compared with the half-year to March 31st, 1905. The principal increase was under the heading of "Working expenses at stations," the total expenses under this head being £157,100 against, for the corresponding period, £145,400, or a difference of £11,700. Salaries and wages accounted for £5,500, while the contributions towards the expenses of stations worked by other companies with which they were associated had increased to the extent of £6,000. With a view to improving the service to South Africa, it had been found advantageous to alter the system of working the West Coast route, and for this purpose arrangements were made to carry the cable into the Madeira station of the Western Telegraph Co., who dealt with the traffic over this line on their behalf. As a set-off against the increase under Abstract B, general expenses in London showed a decrease of £1,500, while the expenses attending maintenance of cables were £8,000 less than they were in the corresponding half-year. They had recently built a small cable-repairing steamer, named the *Sentinel*; she would be stationed on the West Coast of Africa, where a considerable proportion of cable was laid in shallow water. The amount of £115,000, representing the balance of expenditure on new cables, had been written off during the current half-year. This completed the outpayment for the new cables from Great Britain to the Cape and to Mauritius, &c., and was their contribution to the new main route to Australia *vid* South Africa. The large sum involved, about £2,000,000, had been met out of their reserve fund, and the financial operation had taken seven years to complete. They could not have done this in so short a period had their traffic not been abnormally increased owing to the South African and Russo-Japanese wars. The policy adopted by the directors of applying the reserve fund from time to time, as necessity arose, in strengthening the system and so giving a better service to the public, enabled them to deal with the increase of business which they hoped would accompany the important reductions of rates and the increasing development of the world's commerce. The general reserve fund now amounted to about £1,000,000, and, in view of their possible cable requirements in the future, he would like to see it increased as much as their ordinary dividends would permit. They would, no doubt, be able to add to this fund in future, but, unless something unforeseen happened, they could not expect to be able to carry such large sums to reserve as they had been able to do during the last five years.

Sir J. DENISON-PENDER seconded the motion.

A SHAREHOLDER suggested that the board might consider the question of starting a provident fund for the staff, so that provision might be made for the widows and families of deceased officials.

The CHAIRMAN said the company had a pension fund. Without going into the matter, he would only say that cases of need were generally dealt with by the board, but it was not their intention to start a fund for widows and families.

The report was adopted without further discussion.

Anglo-American Telegraph Co., Ltd.

THE directors' report just issued states that the total receipts from January 1st to June 30th, 1906, including the balance of £847 brought forward from the last account, amounted to £204,919. The traffic receipts show an increase of £17,801 as compared with the half-year ended June 30th, 1905. The working expenses of the half-year, as shown by the revenue account, amounted to £80,224, being an increase of £9,299 as compared with the corresponding period of 1905. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, were paid on May 1st, 1906, absorbing £52,500, and second quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 4th, 1906. The balance of £19,695 will be carried forward. The directors greatly regret to announce the resignation of their esteemed colleague, Mr. William S. Cunard.

The Consolidated Electrical Co., Ltd.

THE fourth annual general meeting was held on Thursday of last week at River Plate House, E.C., Mr. Herbert Allen in the chair.

The CHAIRMAN, in moving the adoption of the report (ELECTRICAL REVIEW, p. 147), said they met under happier conditions than usual. In consequence of their having sold their Canonbury business, the balance-sheet had been remodelled. The items that stood last year as "plant, machinery and buildings" at £9,539 and "stock in trade £11,693," figured now as £15,000 investments, and sundry debtors £4,732. Another change in the balance-sheet was the list of their investments in other companies. Of course, one investment that overshadowed all the others was the Anglo-Portuguese shares. They themselves virtually controlled that investment, for they had 70,000 shares out of 100,000, and without reflecting any discredit upon the Anglo-Portuguese board, he considered that it was largely due to that control that the Anglo-Portuguese Co. was in such a sound position. As long as they held these shares they were sure of a satisfactory state of affairs. The £3,000 in the Consolidated Supply Co. was as good as sovereigns, and their security was unimpeachable. When they came to the 15,000 shares in the Consolidated Supply Co. he admitted that they had a more difficult problem to face. They came by these shares, as they knew, by the sale of their Canonbury plant. The value of those shares depended upon the ultimate success of the Supply Co., and they had in the meantime left them out of the balance-sheet. They could have made the balance-sheet look more rosy, either by swelling the item on the reserves or reducing the goodwill by £15,000. That was a pleasure he hoped yet was in store for them. The Supply Co. had placed some of their shares at par in other directions independent of their company, and he only hoped that Mr. Baylor would be able to raise more capital for that undertaking in the same way. They had little to complain of with regard to the progress of the Supply Co. They had written off entirely an amount of £4,155 representing shares, for, as he told them last year, their value was a very remote figure, and their repeated appearance in the balance-sheet would only lead to confusion. Of course there was a wide distinction between those shares and those of the Supply Co The goodwill had been written down by the substantial sum of £16,222, which had reduced that item from £66,518 to £50,296, and he saw no reason why if they continued that policy they would not be able in the next two or three years to get rid of it altogether. Sundry debtors might at first sight look a large item, but that included £4,732 due to them on the Canonbury sale, and £2,467 which represented the adjusting of certain old accounts, for which they took debentures of the Supply Co. The profit and loss accounts showed a total income of £22,677, but the greater part of that was exceptional. Their income amounted to £4,710, apart from the extra dividend received from the Anglo-Portuguese Co. He was not desirous of laying too much stress on £858, which was a part of a sum of £2,000 payable to them by the Supply Co. in commutation of any profits which they might have made. It was really a book-keeping profit. The total expenses, as shown by the revenue account, amounted to £1,911, an increase of £358. The greater part of that increase was due to the fact that certain salaries which appeared in the trading account last year now appeared in the profit and loss account. The Canonbury factory, although disposed of in March, 1905, was not really taken over until the following October or November, and several heavy salaries in the interval had to be paid by them. Their legal charges had been somewhat heavy during the past year, but he did not suppose they would occur again to the same extent. They had taken advantage of their exceptional year to straighten up their accounts, by writing off a nominal asset which figured in last year's balance-sheet. He referred to the expense of £1,765 incurred upon the preference shares issued in 1903. He considered that the issue was really the salvation of the company, and they must not grudge the expense incurred. Another gratifying feature of the year was that they had cleared off all the arrears on the preference dividend. They had after setting all their finances in order a balance of £13,861. The preference dividend would absorb £2,081, and they had now nominally left £11,779 to deal with. They felt that a conservative policy would commend itself to the majority of the shareholders, and some of the nominal profits of the year were not realised profits. They, therefore, proposed a dividend of 3 per cent., which would leave a surplus of £8,479 to deal with during the coming year. That surplus was represented in the balance-sheet by Anglo-Portuguese shares. Their first year's working, as they knew, was in the nature of an experiment, and they suffered a heavy loss. In the second year there was a further loss on the trading account, but it was offset by profits from other directions. They then resolved to give up their manufacturing business, and they then for the first time showed a handsome profit, and that was all the more creditable as it was done at a time when many other similar companies were on the down grade. Their current year would show even a more prosperous trading, as the whole of their 72,000 Anglo-Portuguese shares would rank for dividend instead of only 50,000 as last year. Indeed, he would be disappointed if they did not earn a dividend of 4 per cent. or 4½ per cent.

Mr. CHARLES WOOLLEY seconded the motion, which, after some discussion, was agreed to.

Mr. LAWSON (a shareholder) proposed:—"That in consideration of the exceptional services rendered to the company by the chairman (Mr. Herbert Allen) during the past three years, there be voted to him a sum of 500 guineas from the surplus profits of the year ending March 31st, 1906." He said that the accounts which they had just passed were the best that the shareholders had ever received. In the Anglo-Portuguese shares they had an asset which represented to the shareholders a profit of between £33,000 and £34,000. That result was entirely due to their chairman, and therefore it would be only a very small acknowledgment of his services if they voted him the 500 guineas he proposed.

Mr. B. H. EVANS seconded the resolution, which was carried with one dissentient.

The CHAIRMAN having thanked the meeting for the vote, the proceedings terminated.

Diesel Engine Co., Ltd.

Mr. C. C. Ellis presided at the meeting of this company held at Cannon Street Hotel on 26th ult., and in moving the adoption of the report, he said that the balance-sheet, though not what they would call satisfactory, was by far the best that the company had ever presented. They were not likely to have more balance-sheets without a substantial amount to the credit of profit and loss account. They were receiving many more orders than ever before, and they were good orders. Internal combustion engines had had an uphill fight, but they were getting well over that now. This year they had gone in for a good deal more advertising and exhibiting, and their efforts in that direction had been very successful. The orders in hand were for more than 5,000 h.p., and a great deal of this was due to their engines having been seen at the Olympia and Liége exhibitions and elsewhere. They were also receiving numerous inquiries. If the business continued as at present, he had hopes that their next meeting would be a merrier one, and that they would have something to declare. A meeting would be called shortly to consider a scheme for a reduction of capital. The report was adopted.

Thos. Parker, Ltd.

The twelfth annual meeting was held at the works at Wolverhampton, on Monday, Alderman C. T. Mander, J.P., presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, July 27th, p. 143), said it would be observed they had gone through the past year with very unsatisfactory results so far as the figures were concerned. This was not due to any lack of energy or hard work on the part of the management and staff. Everybody in the place had thrown his whole efforts into the work, but the condition of the market had made it impossible to get a proper reward. There were too many works to meet the demand, and it was simply a question of the work going to the people who would quote the lowest price, and in the generality of cases during the last year or two these prices had carried practically no profit. This condition would no doubt adjust itself in a short time. They were, however, in a much happier condition at the present time than they were when they met last year, as their shops were rapidly filling up with orders, whereas at this time last year they were at the end of a long period in which they had been emptying. Improvement had been steady for the last six months, and the orders taken in the present month were more than they had had during any month for the last two and a half years. It was found that the new design of the patent "C" type dynamos and motors had been of great help in working up the speed of the place again. This type was put on the market about a year ago, and they had met the modern conditions admirably, as evidenced by the monthly increases in the orders taken for them. The adoption of auxiliary poles to all the dynamos and motors about 18 months ago was a step which was decided on after very careful consideration, as its adoption meant the complete disorganisation of the shops, due to the alterations necessary to the proportions of the machines and existing patterns. It was considered good policy, however, to be among the first to take the step, as the directors were convinced that it was a coming necessity, and that later on all manufacturers would have to make a similar change. The effect of this, however, on the output from the shops could not be avoided, and this was reduced by about 40 per cent. of what was turned out two years ago. They had been devoting a large amount of attention to broadening the base of the company's operations, and were developing certain patents which they found the shops admirably adapted to deal with. These additions would no doubt help to keep the shops full when electrical work was slack. This was the whole question between profit and loss. They had a certain amount of standing and staff charges, which in such a technical branch of engineering as the electrical industry were necessarily heavy, and which could not be reduced without sapping the vitality of the place, and it required a certain turnover to pay for these, which they did not attain last year. Their various agents round the country reported very favourably with regard to the type of machinery they were now selling, and with all this, in addition to the increasing base of operations which they were getting, they should be able to meet in another year or two under happier conditions.

The report was adopted.

Alderman Mander was re-elected a director of the company, and Mr. W. A. Nelson was re-elected auditor.

Dr. Gaskell expressed the hope that the shareholders would be supplied with a report in six months' time in regard to what progress had been made.

Mr. Armistead said, if anything arose, shareholders would be made acquainted with it.

Crompton & Co., Ltd.

The report of the directors, to be presented at the annual meeting at Salisbury House, E.C., to-day (Friday), states that the contract department of the company has again made a satisfactory profit, and they are glad to report that, although selling prices are still low and competition keen, the results of the year's working at the company's works at Chelmsford show a marked improvement. During the financial year an extension to the lamp shop has been completed and equipped with the necessary machine tools. The economies at the works referred to in last year's report, improvements in manufacture and an increased output aided by this extension, have all contributed to produce a better result. The net profit for the year amounts to £20,060, as compared to £9,129 in the preceding year. After providing debenture interest and other items shown in the net revenue account, there remains, with the sum brought forward from last year, an available balance of £13,373. The directors propose to declare a dividend of 2½ per cent. per annum for the year, to place £1,500 to reserve for doubtful debts and contingencies, and to carry forward a balance of £5,817. The directors have pleasure in reporting that the company has transferred to the Madras Electric Supply Corporation the licence obtained for electric lighting in that town, and that a contract has been secured from the corporation for the complete equipment of their undertaking in Madras for the sum of £174,534. The amount of work in hand at the commencement of the current financial year is largely in excess of the figures for any previous year, and the prospects of the company may, therefore, be considered satisfactory.

Last year the dividend was at the same rate, £4,000 was placed to reserve and £656 was carried forward.

Great Northern, Piccadilly and Brompton Railway Co.

Sir G. S. Gibb (the new chairman) presided at the half-yearly meeting, held at Hamilton House on Tuesday, and moved the adoption of the report (Electrical Review, p. 147), which, he said, recorded the steady progress of the undertaking. Work had proceeded without mishap or check, and they could now look forward with confidence to its completion in January next. The rolling stock was beginning to arrive; already there were 75 cars in England. Those cars would be completed at the Lilley Bridge car shops, and they anticipated no delay either in regard to completion of the rolling stock or in regard to any other part of the work. Shareholders would wish to associate themselves with the expression of regret at their losing the services of Sir Henry Fowler and congratulation upon his appointment as a Cabinet Minister.

The report was adopted and a resolution passed declaring a dividend of 4 per cent. per annum out of the rent received from the Underground Electric Railways Co. of London, Ltd.

City and South London Railway Co.

The forty-fourth ordinary general meeting of this company was held on Tuesday at the offices, 71, Finsbury Pavement, E.C., the Rt. Hon. C. B. Stuart-Wortley, K.C., M.P., presiding.

In moving the adoption of the report (Electrical Review, p. 143), the Chairman said that the directors were able to pay a dividend of 2¼ per cent., as against 2 per cent. for the corresponding period of last year, and to carry forward a sum of £1,870. During the half-year they had carried 382,532 more passengers and had received £1,561 more in receipts. This was in spite of the fact that there had been a reduction in the number of season ticket holders, some of the previous holders preferring to take the 6d. return tickets. The total expenses continued to show a decrease. Receipts per train were 16s. 0·40d., against 16s. 3·70d., and the receipts per train-mile were 2s. 7·41d., against 2s. 7·95d. Per passenger the receipts were 1·80d., against 1·84d. The shareholders would be pleased to know that the works in connection with the Euston extension were progressing very satisfactorily. As they had been told before, there had been some delay occasioned by a very considerable portion of the tunnelling having had to be carried out under compressed air. This had occurred west of King's Cross and St. Pancras, and the cost had been allowed for in the estimates. Then they had encountered a certain amount of rock west of the Angel, but the delay occasioned by this ran concurrently with the delay west of St. Pancras, and so would not affect the date of the opening of the extension. The tunnels under the great roof of St. Pancras had been carried out without any damage being done, and of the whole length of running line only some 140 yds. had now to be completed. The shareholders would see, therefore, that they were much nearer realising the great possibilities they anticipated when the extension was opened. As they knew, they were making a connection with the Baker Street and Waterloo Railway at the Elephant and Castle, and from information he had just received he was able to state that that would be opened earlier than was anticipated, on next Sunday in fact. It would take only a minute or less to walk from the platforms of one company to those of the other. When that connection was opened, they would have the most complete, and the newest and quickest route from the Angel to Waterloo, where lifts would take passengers on to the platforms of the South Western Co., to Charing Cross, Trafalgar Square, and to all the other places the lines served. Passengers would be able to book through from one line to the other. He was glad to say that their relations with the Baker Street and Waterloo Co. were most friendly, so that everything was being done to expedite matters. For the past 16 years the company had suffered from not being able to take its trains out of the tunnels for cleaning, in a way that was at all adequate. At Stockwell they had a very steep incline up which the trains were drawn by means of a steel cable, but the arrangements were costly, and not at all satisfactory. They led to stoppages, and were in other ways very inconvenient. Now they were going to alter all that, and had set about the making of two sidings at Stockwell for this purpose. They had sunk a large shaft, by means of a lift in which the carriages would be brought up to the surface, and so properly cleansed in the depôt. The cost would be no greater than the old incline, so that they would have a great improve-

ment at no additional expense. The directors gave the closest attention to the keeping down of expenses, and had set everything in motion to secure that end. They had begun the half-year with an unusually good traffic, and he felt that they were justified in looking forward, particularly when the wealthy West End was connected up, to a prosperous future.

Mr. Seymour Grenfell seconded the motion.

Mr. Andrews, a shareholder, asked if the chairman could say if anything in particular had led to the recent increase in passengers; they had had a spell of fine weather during the past week or two, but he had generally found that fine weather tended to reduce the passengers carried, while wet weather sent them up.

The Chairman said that some of the increase might be due to the disorganised state of the trams in the north of London, but that could not account for all, as the increase had been general all over the line.

The report was then adopted, and a vote of thanks to the chairman concluded the proceedings.

Metropolitan Railway Co.

In the course of his speech at the half-yearly meeting of this company last week, Sir C. McLaren, M.P., the chairman, said that they had felt motor-'bus competition very keenly. He called attention to the fact that the railway company were compelled to contribute large sums by way of rates for the maintenance of public roads, the wear and tear on which was largely and in a growing measure due to vehicles of this character competing with railways like theirs. In consequence of the expensive buildings and plant they had had to erect in connection with their electrification, their assessments at Neasden and elsewhere were being put up, and they could not but regard this as very unfair, seeing that what they had done simply constituted a change from one mode of locomotion to another. The electrification of the Hammersmith and City Railway had taken longer than was expected, and the contractors for the rolling stock were also behind in the delivery of the trains for that service. They very much regretted the delay in getting rid of the steam out of the tunnels, but it was not through any fault of theirs. The beneficial results of electrification could not appear until steam trains were removed entirely, and they were still hopeful that when this was accomplished a very great difference in their traffic returns would be seen. They had had a large number of breakdowns of the electric trains, especially during the earlier months of the half-year. The fault lay entirely with the car equipments, for which, of course, the contractors, the British Westinghouse Co., were responsible, the equipments being still in their hands, as the board had not up to now been sufficiently satisfied with them to take them over. The main fault lay in the character of the controllers provided on the motor-cars. At the time they placed the order similar controllers had, they were assured, been working satisfactorily on important lines in America and elsewhere, and there was apparently no reason why they should not do equally well here. However, it proved not to be so, and the contractors were still engaged in taking all these controllers out and replacing them by others of a new design, which they were advised were superior and better adapted for the conditions of their system. For their further information he might say that the controller had been changed on about one-third of the trains, and the Westinghouse Co. estimated that within two or three months the work would be completed. With all these things against them it was inevitable that they should make a poor showing, but he thought that they had now touched bottom. They hoped to get some of the Hammersmith and City trains running electrically in the course of a few weeks, and this, together with the more regular running of the trains on the circle, should tend to help the receipts.

South Wales Electric Power Distribution Co.

On Wednesday last week an interesting and important meeting of the debenture holders, consumers and others concerned in this company's future was held at Cardiff. (A complete report of the meeting appears in the *Western Mail* for July 26th, from which our extracts are made.) Mr. Robert Fleming, of London, presided, and he was supported by other members of the debenture-holders' committee. Both Mr. C. H. Merz and Mr. W. A. Chamen (the present engineer and manager of the company) were present and addressed the meeting.

The object of the gathering was explained by the Chairman, who said he would call upon Messrs. Merz and Chamen to speak in a practical way, and discussion would then follow. It was no use reverting to the past, which had been most unfortunate. The question they had to decide was the best way of getting out of their unfortunate position, so as to improve their security and give consumers a reliable supply of power. Two or three months ago, for the first time, they were made aware of the precarious position of the company. They had conferences, and they immediately engaged the best engineering talent they could command to come down and look the situation over, and they came to the conclusion that the concern was worth saving. Their next consideration was as to how it could be saved, from a purely financial point of view. They looked at the Bill promoted in Parliament for increasing the capital of the company, and found it would not cover the ground. The Bill was radically changed, and had passed both Houses of Parliament. Under this Bill they had power to issue securities that would enable them to do what they wanted—raise money enough to put the plant in first-class condition—in fact, to make an entirely new plant which would produce power on most economical terms, and be reliable in every respect. The next question was: Could they get the money to do it? They had come to the conclusion that they could raise the money with proper co-operation and help on the part of the consumers, and that a first-class plant on which they could all rely could be placed in the district. Those who had indicated their willingness to advance the money made one condition as an absolute essential, and that was that there should be some guarantee that the plant being there the customers should take the power from it. They had been disappointed in the past with the slowness with which connections had been made, and it would be impossible to raise the money unless something definite was secured in advance in that direction. The object of the meeting was to secure from those present at that meeting promises to take power to an extent which would sufficiently secure a moderate return upon the capital invested.

Mr. C. H. Merz said he was not connected with the old scheme in any way, and until a month ago he had not been over their district. He had since then covered the district fairly fully, and had spent a considerable amount of time in calculating what could be done in the district. He did not think there was any question at all that the district could be supplied with power much more cheaply from a central plant, from a comprehensive system for the whole district, than by individual plants installed by the different collieries. He did not know of any district in the kingdom where there would be more advantage from carrying out the scheme in a comprehensive way. That arose for one reason, because the water supply must be a difficulty in the case of many plants. He knew from the engineers to the biggest installation which had been put up in their district—the Powell-Duffryn—that they had to go in for engines, and could not go in for the advantages of steam turbines largely because of the difficulties of obtaining water for condensing purposes. Those difficulties were got over by having a comprehensive scheme. The South Wales district, ten years hence, would be at a great disadvantage to the extent of tens of thousands, and, perhaps, hundreds of thousands of pounds, if it were developed by individual plants as distinct from a comprehensive scheme. They could buy a 15,000-H.P. turbine for a third of the price per H.P. they had to pay for a 500-H.P. turbine. What was the use of buying a lot of 500 H.P. turbines, or turbines of that order? He urged them to seriously consider whether it was not the right thing to get a proper scheme started. In view of the unsatisfactory nature of the past scheme, one of the questions they would raise would be the reliability of supply. He understood that latterly the installation of the company had run fairly well, but he could only say that in the North of England, where he was connected with a fairly large power scheme, he never had any hesitation in advising the biggest firms to depend upon the power company for their supply. They could go down the north bank of the Tyne and they would have a difficulty in finding a steam engine of any kind. They would find even the railways run by electric power, all taken from the comprehensive supply system which was now installed throughout Northumberland. Therefore, there was no question about the reliability. Firms like the Armstrong-Whitworth Co., with a capital of 10 millions, were not going to take their power supply from a power company unless they were satisfied it was right. It was proved to be right up there. No doubt the cost of supply had come up before them in some detail in connection with the present scheme, but he would like to point out that the people who originated the old scheme made a great mistake in the way they put things before the consumers. They had not put the power before them on such terms that they could afford to use it for all purposes. He was a great believer in centralisation. For that reason he was a disbeliever in doing the thing partially. The thing ought, in the first place, to have been put before the consumers in such a form that it would have paid them to use power for all purposes. It seemed absurd to him that they should take a hauling engine at a colliery and displace it by a motor, and not drive their pumps or even their fans from the same source. It was the pumps and fans that consumed the coal, and the power was there to save coal. What was the use of trying to run a power scheme by getting all the machines which did not consume coal and running them from a central spot and leaving all the pumps and other machines, which were running continuously, to be dealt with on the spot? Those were the very things which should be dealt with from a central source. Somehow or other this arose in connection with the starting of this business. The result was that they had not been given terms which would have paid them. From his knowledge of what had been done the power was used chiefly for intermittent work, and the price they paid—$\frac{3}{4}$d. per unit—put in that form would not be remunerative to the company. What was required was a form of tariff or sliding scale which would enable any colliery and any power consumer to run any class of machine with economy. He was satisfied that if they discussed the matter frankly and in the proper spirit it was possible to arrive at a form of tariff or sliding scale that they could put any motor on for any purpose with the full assurance that it would pay them to do so.

The Chairman explained that the debenture-holders were not there in any spirit of antagonism to the board of directors. The present board was not the original board, and Mr. Chamen was not the original manager.

Mr. Chamen said that many present knew he had been speaking for some months on this question of a sliding scale. Perhaps they could leave the figures for the moment and first consider the principle. Several colliery owners had come to him and said that they could not put their pumps and fans on to the company's supply at $\frac{3}{4}$d. per unit. They had put on their haulages and saved considerably, but that had been unremunerative to the company. The colliery companies, having this flat rate before them, had sought about to find the things which paid them best, and they had done the company the honour of giving them those things. They were

very glad to have them, but it was necessary that they should go a great deal further. No concern could make a living by supplying haulages at ⅜d. per unit. He was afraid there was a tendency not to compare things that were equal, but he was sure that those gentlemen present would do their best to consider each case on perfectly fair grounds. If they put in their own generating plant, they at once proceeded to convert everything to electric driving. They put on their fans and pumps and everything else, and in that way they gave to themselves what was denied to the company, viz., a good load factor. He hoped some of the gentlemen present would state what they were prepared to do in the way of entering into binding contracts at a minimum price. That was the most businesslike way of dealing with the matter. There ought not to be a great difficulty in securing a satisfactory number of contracts in order to satisfy the committee that the scheme was worth carrying out.

Mr. Boulter said that the debenture-holders had come down to say that if the colliery owners in South Wales thought that this power scheme was likely to be of service to them in the future, if they were prepared to show that feeling by giving it active and definite support, they would assist the colliery owners to find the £500,000, in order to put the concern on a sound financial basis. This must be a matter of co-operation between the capitalists and the consumers. The prospects of the undertaking were not favourable so far as the capital was concerned. If the debenture-holders found the money they would have to take some risk in the matter, and they looked to the consumers to make up their minds to go definitely into the question, and to say whether they would give the debenture-holders the necessary support. How were they going to find this £500,000? They had had many anxious meetings about this matter. Mr. Merz had been retained by them at their own expense to make a careful and definite report. They had had other engineers of great experience who had done the same thing, and who had advised them in the matter. The conclusion they had come to was this: That if this money was found the concern could be put, certainly as far as the consumers were concerned, upon a thoroughly satisfactory basis, and so far as the capitalists were concerned, upon a basis which, although, as he said, it was not altogether a most favourable one, was still the basis which showed a prospect of providing interest on the new money, and showed some prospect of providing an income upon the old. A condition precedent to finding this money was that the colliery owners should give them their active support. He would not be a party to piecemeal work, and it was upon the basis of Mr. Merz telling them that £500,000 must be forthcoming and be definitely available for the purposes of the company in order to enable the consumers to have a supply at a minimum price, and enable the capitalists to see that they could get a profitable return on their money, that he would approach this scheme.

A general discussion ensued, in the course of which a good many questions were put to Mr. Merz.

Mr. Merz said if the scheme was carried out they proposed putting cables over the whole of the district, so that any colliery could get a supply at a week or a month's notice.

Sir W. T. Lewis proposed the following resolution:—

That a committee of consumers, with power to add to their number, be appointed to confer with the debenture-holders' committee with a view to a guarantee being forthcoming for taking a minimum of power at prices satisfactory to them, should the necessary capital be forthcoming, to place the power company upon a sound commercial basis.

The resolution was carried unanimously, and a committee was appointed.

Bombay Electric Supply and Tramways Co., Ltd.

The report of this company for the period from August 2nd to December 31st last, presented at the first ordinary general meeting at Winchester House on the 31st ult., stated that since the statutory meeting an issue of the company's capital was made by prospectus dated August 8th, 1905, of £600,000 4½ per cent. debenture stock and 60,000 6 per cent. cumulative preference shares of £10 each. The capital expenditure of the company at December 31st, 1905, amounted to £1,116,031, which included the amount of £950,000 payable under the agreement of July 3rd, 1905, with the B.E.T. Co., for the acquisition of the horse tramways, the freehold and leasehold property, goodwill, the concession to convert the tramways to electric traction, and to supply electrical energy for lighting and power. The price includes the completion of certain works in connection with the supply of electricity and all the costs in connection with the formation and registration of the company. The gross receipts to December 31st, 1905, were £44,472; after providing for revenue charges, including repairs and maintenance, £19,121 remained. Deducting interest on the debenture stock and dividend on the 6 per cent. cumulative preference shares to December 31st, 1905, amounting together to £15,958, a balance of £3,163 remained, which the directors proposed should be carried forward.

The electrification of the various routes is progressing, and some seven miles of double track are expected to be in operation early next year.

In regard to the electricity supply section, the equivalent of 36,071 lamps were applied for up to June last, and the company anticipate lighting many public buildings and the docks shortly.

Generating plant of 1,800 kw. has been installed in the power station, and 2,000 kw. of additional plant is being forwarded.

Charing Cross, West End and City Electricity Supply Co., Ltd.—The directors have declared an interim dividend on the ordinary shares at the rate of 5 per cent. per annum for the half-year ended June 30th, 1906. Warrants will be posted on the 15th inst. This is at the same rate as last year's interim dividend.

Great Northern and City Railway Co.—The report for the last half-year states that the total revenue receipts for the six months amounted to £49,390, as against £46,239 last year. The passengers carried during the same periods, excluding season ticket holders, were 6,852,233 and 6,391,574 respectively. The number of local season tickets issued was 3,131, as against 2,913. The number of three-route season ticket holders using the company's line during the past half-year was 2,967.

Waterloo and City Railway Co.—The report for the past half-year states that the gross receipts of the line, less Government duty, amounted to £17,367, and the working expenses to £7,815, as compared with £17,577 and £7,974 respectively for the corresponding period of 1905. A dividend at the rate of 3 per cent. per annum on the ordinary stock will absorb £8,100, leaving £738 to be carried forward. This dividend is at the same rate as for the corresponding period of 1905. The number of passengers (exclusive of season ticket holders) carried has been 2,181,068, a decrease of 38,055. The Bill of the London and South-Western Railway Co., containing powers for the acquisition of this company's undertaking, has now received the Royal assent. The terms of sale, which were agreed to at a special general meeting of the shareholders held on April 5th last, are as follows:—

In exchange for each £100 of Waterloo and City ordinary stock the shareholders are to have the option of taking either £67 of London and South-Western Railway ordinary stock, or £105 of London and South-Western Railway 3½ per cent. preference stock, or £110 of London and South-Western Railway 3 per cent. debenture stock; and so on in proportion for any fraction of £100.

Prospectus.—*Llandudno and District Electric Tramway Construction Co., Ltd.*—This company has been before the public this week (the list was to close on Wednesday) with an issue of 775 shares of £100 each. The company is to complete the construction of and equip and work a system of light electric railways between Llandudno and Colwyn Bay.

Dublin United Tramway Co., Ltd.—Mr. W. M. Murphy presided at the meeting of this company held at Dublin last week. He moved the adoption of the report, which showed that the gross receipts had increased by £1,123, and the expenses by £1,649. The report was adopted.

London United Tramways (1901), Ltd.—The directors have declared a dividend for the half-year ending June 30th last, on the ordinary shares of the company, at the rate of 3 per cent. per annum, being at the same rate as for the year 1905. The dividend will be payable on August 9th.

Melbourne Tramway and Omnibus Co., Ltd.—It is reported that a bonus for the year ended June 30th at the rate of 2½ per cent. has been declared.

Bournemouth and Poole Electricity Supply Co., Ltd.—The directors have declared an interim dividend at the rate of 5 per cent. per annum on the ordinary shares, for the half-year ended June 30th.

Stock Exchange Notice.—Application has been made to the Committee to allow the following securities to be quoted in the Official List:—

Anglo-Portuguese Telephone Co., Ltd.—Shares of £1 each, fully paid.

St. James' and Pall Mall Electric Light Co., Ltd.—The amount of electricity sold during the quarter ended midsummer was 1,695,766 units, estimated to produce £21,894, as against 1,573,443 units, which produced £22,487 for the same period of last year.

North-Eastern Railway Co.—The directors recommend a dividend for the past half-year of 5½ per cent. per annum, carrying forward £62,000; this compares with a dividend of only 4¾ per cent. and a carry forward of £41,349 for the corresponding period of 1905.

Bristol Tramways and Carriage Co., Ltd.—The directors have declared an interim dividend at the rate of 8½ per cent. per annum for the past half-year.

Imperial Tramways Co., Ltd.—The directors have declared an interim dividend to June 30th last at the rate of 8 per cent. per annum.

Electric Landaulet Co., Ltd.—According to the *Times* the directors have declared an interim dividend for the first half of the current year at the rate of 5 per cent. per annum.

City of Buenos Ayres Tramways Co. (1904), Ltd.—A dividend of 1s. 3d. per share has been declared for the three months ended June 30th.

Metropolitan District Railway.—The directors have decided to recommend the payment of a dividend on the 4 per cent. guaranteed stock for the six months ended June 30th last at the rate of 1½ per cent. per annum, the same rate as last year.

Westminster Electric Supply Corporation, Ltd.—The directors have declared an interim dividend for the half-year ended June 30th last at the rate of 11 per cent. per annum. Last year the rate was 13 per cent.

Metropolitan Electric Supply Co., Ltd. — The directors have declared an interim dividend of 4s. per share on the ordinary shares, being at the rate of 8 per cent. per annum. Last year 5s. was paid.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	* £	No. of wks.	Total to date. £	* £	Route miles open.	*
Aberdeen	July 25	3,520	+ 51	8	12,225	— 162	14·4	..
Ayr	,, 21	1,398	+ 60	10	3,892	— 76	8	..
Bath	,, 25	1,966	+ 375	30	23,156	+ 3,630	18	..
Belfast	,, 7	7,013	+2,460	30	96,342	+26,756	40	+ 6½
Birkenhead	,, 29	2,257	+ 11	17	18,418	+ 122	13·5	..
Blackburn	,, 25	2,171	+ 70	17½	18,735	+ 1,099	13·5	..
Blackpool Corp.	,, 26	4,020	+ 185	17	19,821	+ 674	11·87	..
,, —Fleetw'd	,, 28	2,617	+ 360	4	4,506	+ 342	8·25	..
,, —Lytham	,, 26	1,585	+ 14	38	12,072	+ 1,309	7½	..
Bolton	,, 29	4,457	+ 321	17	37,379	+ 2,351	36	+ 1
Bournemouth	,, 25	3,488	+ 275	16½	27,592	+ 6,114	18·75	+ 6½
Bradford	,, 28	9,643	+ 343	17	79,870	+ 3,228	58	..
Brighton	,, 29	2,234	— 321	17	17,074	..	9·5	..
Bristol	,, 27	10,838	— 74	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	July 20	439	+ 8	29	6,360	+ 605	3·65	..
Barnsley	,, 20	319	+ 5	,,	4,139	+ 30	..	..
Barrow	,, 20	629	+ 48	,,	6,988	+ 337	5·37	..
Cavehill	,, 20	385	+ 244	,,	2,434	+ 856	..	..
Devonport	,, 20	1,073	+ 39	,,	12,806	— 408	8·85	..
Gateshead	,, 20	2,270	+ 355	,,	27,648	+ 1,575	11·25	..
Gravesend, N'fleet	,, 20	545	— 12	,,	6,676	+ 268	6·5	..
Greenock	,, 20	1,324	— 243	,,	18,757	+ 668	7·25	..
Hartlepool	,, 20	724	+ 106	,,	8,265	+ 868	6·72	..
Kidderminster	,, 20	353	— 4	,,	3,295	— 54	..	..
Leamington	,, 20	462	+ 147	,,	4,384	+ 2,855	3	..
Merthyr	,, 20	401	— 1	,,	5,557	+ 52	2·9	..
‡Metropolitan	,, 20	7,624	+ 602	,,	95,688	+25,639	22	..
Middleton	,, 20	829	— 160	,,	9,985	+ 239	8·5	..
Mid. Joint Com'tee	,, 20	20,540	— 831	,,	294,123	+18,786	..	..
Oldham — Ashton	,, 20	1,227	— 27	,,	16,121	+ 480	9·13	..
Peterborough	,, 20	408	+ 79	,,	3,537	— 321	5·31	..
Potteries	,, 20	8,454	+ 39	,,	50,968	+ 2,551	29	..
Rothesay	,, 20	1,489	— 22	,,	5,373	+ 1,079	2·75	..
Southport	,, 20	810	— 10	,,	8,745	+ 111	8·17	..
Swansea	,, 20	1,835	+ 42	,,	22,957	+ 4,384	5·5	..
Tynemouth	,, 20	759	— 115	,,	6,827	— 256	3·75	..
Weston-s-Mare	,, 18	646	+ 3	,,	3,040	+ 124	3	..
‡Worcester	,, 20	679	— 64	,,	7,816	— 709	5·75	..
Wrexham	,, 26	217	— 8	,,	2,864	— 12	..	..
Yorks. Wool. Dist.	,, 20	1,873	+ 369	,,	25,546	+ 7,461	17	..
Miscellaneous	,, 20	235	— 67	,,	2,848	— 449	..	..
Burnley	,, 28	2,238	+ 79	29	..	..	7·5	..
Burton-on-Trent	,, 29	656	— 37	17	5,260	— 369	9·5	+ 1
Bury	,, 22	2,053	..	16	16,284	..	10·5	..
Cardiff	,, 21	4,345	— 54	16	33,533	— 1,170	15·87	..
Carlisle	,, 28	434	— 38	30	5,422	— 62	..	..
Chatham and Dist.	,, 26	1,527	— 258	30	19,044	— 431	10·29	+ ·96
Colchester	Mar. 7	327	— 5	31	5,660	..	7½	+ ½
Cork	July 26	1,165	— 46	30	14,057	— 395	9·89	..
Croydon	,, 27	1,109	+ 96	8	13,296	+ 987	11·25	+ ·5
Darlington	,, 28	450	+ 1	17	3,652	..	4·27	..
Darwen	,, 27	473	— 10	17	4,343	+ 114	4·36	..
Dover	,, 14	631	+ 106	15	3,858	+ 514	4·75	+ 1½
Dublin	,, 27	11,480	+ 289	4	21,412	— 435	18·75	+ ·25
Dundee	,, 11	2,223	+ 479	28	8,877	+ 1,797	12·5	..
East Ham	,, 30	1,891	+ 111	17	16,219	+ 1,538	8	+ ½
Exeter	,, 27	634	— 26	17	4,975	— 451	4·25	..
Glasgow	,, 28	27,614	+1,535	9	139,425	+ 8,599	81·25	+ 5½
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	July 25	3,386	— 129	17	28,937	+ 1,188	37	+ 1·5
Hastings	,, 27	1,610	..	..	..	..	..	..
Huddersfield	,, 28	3,122	+ 181	17	26,338	+ 2,554	28	..
Hull	,, 28	4,681	+ 230	17	38,513	+ 1,116	13	..
Ilford	,, 28	1,025	— 49	17	8,787	+ 118	6·37	..
Ilkeston	,, 25	283	+ 23	17	2,258	+ 101	3·5	..
Ipswich	,, 28	1,054	— 6	17	7,634	+ 214	10·5	..
Isle of Thanet	,, 28	2,486	— 199	30	14,884	— 823	11	..
Kilmarnock	,, 28	453	— 15	11	1,920	— 84	4·12	..
Kirkcaldy	,, 25	626	— 3	..	..	..	7·5	..
Lan'kshire Trm Co.	,, 26	1,823	+ 97	30	25,919	+ 5,682	12·56	+ ½
Leeds	,, 21	12,778	+ 355	16	101,954	+ 4,454	96	+ 6½
Leicester	,, 28	4,768	+ 1	30	65,535	+ 4,430	..	..
Leith	,, 21	1,186	+ 602	9½	5,291	+ 2,826	6	+ 1
Liverpool	,, 21	22,480	— 250	29	308,141	+ 5,541	104	+ 1
‡L.C.C.	,, 14	53,587	..	15	174,553	..	94	+ 42½
London United	,, 27	14,781	+ 617	30	181,302	+10,248	..	..
Lowestoft	,, 21	505	— 100	21	6,075	— 504	3·5	..
Manchester	,, 28	27,767	—1,090	17	233,608	+ 8,742	84	..
Newcastle	,, 14	9,024	+1,739	15	62,736	+ 4,380	25·5	..
Newport	,, 14	1,304	+ 21	15	9,524	+ 378	14·5	+ 1·5
Northampton	,, 27	988	— 2	17	7,740	+ 33	5·5	..
Oldham	,, 29	3,830	+ 401	18	32,559	+ 2,675	23·75	..
Pontypridd	,, 28	321	+ 11	17	2,920	— 1	3·5	..
Portsmouth	,, 28	4,698	+ 98	17	35,547	— 82	14·5	..
Preston	,, 11	1,612	+ 279	..	..	..	10	..
Reading	,, 26	1,379	+ 64	17	10,823	— 61	7·5	..
Rochdale	,, 28	2,177	+ 384	17	18,344	+ 5,790	20·6	+ 1½
Rotherham	,, 26	1,018	+ 109	17	8,391	+ 728	9·33	..
Salford	,, 28	9,279	—1,308	16	74,490	+ 189	38·9	..
Sheffield	,, 29	10,823	+ 252	18	95,286	+ 4,949	35·75	+ 1½
Southampton	,, 25	2,163	+ 3	16½	16,404	+ 18	..	..
Southend-on-Sea	,, 25	1,045	— 44	17	6,708	+ 112	6	..
†Stalyb'dge, Hyde, &c	Apr. 21	807	+ 100	3	2,456	..	21	..
Stockport	July 21	2,049	+ 49	16	16,021	+ 5,265	15·5	+ 4
Sunderland	,, 15	3,154	+ 59	15	21,471	+ 1,109	10·87	..
Swindon	,, 8	331	— 83	13½	2,642	— 49	4·4	..
Tyneside	,, 25	935	+ 9	30	13,442	+ 855	8·87	..
Walthamstow	,, 28	1,959	..	17	11,017	..	10	..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
West Ham	July 26	4,709	+1,195	17	39,410	+12,240	14·7	+ 8½
Wolverhampton	,, 26	1,746	..	..	..	..	10	..
Yorks. W. Riding	,, 29	1,742	+ 114	30	24,312	..	..	..
Baker St.-Waterloo	,, 28	2,603	..	4	5,489	..	3·25	..
Cen. London Rly.	,, 28	11,343	— 276	4	23,370	— 673	6	..
City & S. Lon. Rly.	,, 29	5,198	+ 700	4	10,117	+ 1,061	6·25	..
Dublin-Lucan Rly.	,, 27	306	— 1	4	536	— 44	7	..
G. N. and City Rly.	,, 28	3,175	+ 299	4	6,499	+ 657	3·5	..
L'pool Overh'd Rly.	,, 29	3,155	— 162	4	6,273	— 296	6·75	..
Mersey Railway	,, 28	3,275	+ 321	4	6,467	+ 541	4·5	..
Metropolitan Rly.	,, 29	29,805	—4,627	4	60,531	— 9,339	70·5	..
Met. District Rly.	,, 29	15,210	+2,470	4	31,377	+ 4,537	24	..
Anglo-Argentine	,, 29	27,768	+2,513	30	442,609	+46,279	43	..
§Auckland	June 22	10,225	+1,319	25	61,419	+ 4,193	18·64	..
§Brisbane	,,	11,595	+1,506	..	..	..	..	..
§Brit. Columbia Rly.	,,	14,761	+3,724	52	186,188	+47,801	..	..
Bu'n's A'r's E.T.Co.	,, 30	2,400	+ 194	26	35,846	+ 6,840	24	..
Bu'n's A'r's-Bigr'no	,, 22	7,482	+ 763	29	103,390	+ 6,208	..	..
Calcutta	July 28	5,781	+ 511	..	..	..	..	..
§Cape Electric T. Ld.	May	14,806	..	..	..	..	..	..
§Geneva	June	7,905	..	..	..	..	..	..
Perth (W.A.)	July 27	2,854	+ 224	30	44,581	+ 2,658	34·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Several of the Stock Exchange markets are—comparatively speaking and allowing for the season of the year—quite busy. For one thing, there has been a rise in South African shares, which rise has heartened things up considerably all round the Stock Exchange. Then, markets are escaping from the incubus imposed upon them by the gravity of the situation in Russia. Railway dividends and traffics are mostly good, and confidence looks like creeping back to Capel Court. If it were not for the holidays—but most of us have children, and those who have not are mostly as keen as children upon holidays, so it is no use complaining on that particular score.

Electricity Supply shares have little to boast about so far as prices are concerned, but in the market we are assured that the general tone has taken a decided turn for the better. It was timidly suggested that shareholders might prefer better prices and a dull tone to lower values and a cheerful sentiment, but this met with scowls, and flippancy does seem out of place in this unfortunate section. Charing Cross Preference of both kinds have risen 2s. 6d. upon the declaration of the 5 per cent. dividend on the Ordinary shares, and Urban Ordinary are 5s. harder, a few buyers having appeared where previously there were but sellers. Weakness in Westminster Ordinary is difficult to explain. Other changes are mostly due to the incidence of dividend deduction. Edison & Swan shares have been inquired for at 32s. 6d., a rise of half-a-crown: it is worth noticing that the time for the dividend declaration draws near.

Manufacturing shares are firmer in some instances, Crompton's, for example, the price advancing to 1⅞, while the Debenture is up a point. Westinghouse Preference receded to 1⅞, and Brush Preference went lower to 30s. British Insulated Preference are 5¾ *ex* dividend.

Telegraph descriptions give the commentator most trouble this week; there are so many alterations in consequence of the *ex* dividend markings. Most of the movements are insignificant when this is remembered, but the Anglo-American group has hardened, the Deferred rising ¾ and the Preferred 1½, reckoning the dividend on the latter. Direct United States Cable are about eighteenpence higher, the distribution being 6s. 6d. per share. Eastern Telegraph Ordinary has recovered 3 points of the 3½ deducted, but China shares have not changed. Attempted sales of Great Northerns in an unwilling market have reduced the price 1½ to 38½. Indo-Europeans, however, are 10s. better. The Globe Telegraph pair reflect the dividends in their slightly lower quotations, and Submarine Cables Trust Certificates are a point higher. Of the movements in prior-charge stocks, a rise of 2 in Amazon Debentures, making the price 84½, is the principal feature. The shares, too, are 5s. better.

National Telephone Preferred and Deferred stocks, and the three kinds of Preference shares, are all *ex*, the dividend on the First and Second Preference being nominally retained in the quoted prices. United River Plate Telephone shares are ¼ higher at 7 middle. Marconi's are unchanged.

With a rise of 3 points, City and South London Ordinary stock has attained 46 middle, the buying being based upon the promising nature of the report. Central London Ordinary dropped 1 to 86, also upon the report, which holds out no present prospect of the other "tube" and motor-'bus competition being slackened. Baker Street and Waterloo Debenture is still a shade below 90. It remains to be seen whether the alteration in the fares will do this apparently little-wanted railway much good. But possibly the public are not yet sufficiently acquainted with the line to patronise it. Underground Railways Profit Notes have fallen 2, holders feeling anything but easy as to the outlook of this curious parental concern. The feature of the week was the smart rise in Metropolitan Consolidated to 67, *ex* 15s. dividend, but the price relapsed 2 points subsequently. Statements made at the meeting confirmed the suggestion here that the company is now within sight of the end to its worst troubles. Investors have been, and are, buying the stock as a good speculative lock-up. Districts are 25.

Long moribund, New General Tractions are being brought to life by inquirers willing to pay 22s. 6d. for the Ordinary and about 3⅞ for the Preference. Dublin United Ordinary have nominally risen 16s. and the Preference 6s., but the prices in the Official List have been wrong for weeks past. Even London United Preference are 5s. up, at 8½, and the Debenture improved a point to 94½. But British Electric Traction Preference are ½ lower. New Calcutta Trams put on ⅝, restoring them to the same price as that prevailing before last week's decline, and Hastings and District Preference hardened to 4⅜. Just previously the price was no better than 4. It is said that the Hastings Corporation has granted permission for the trams to run on Sundays, so that if there are any strict Sabbatarians amongst the holders of these tramway shares, they must regard the improvement in their property with contradictory feelings.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations July 24th.	Closing Quotations July 31st.	Business done week ended July 31st, 1906.		Rise + or Fall —
			1903.	1903.	1904.	1905.			Highest	Lowest.	
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	2¾ — 3¼	..	..	+ ¼
155,600‖	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	80 — 85	83 — 88	..	..	+3
709,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	65 — 67	65 — 67 xd	65	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼ %	6 %	112½ —113½	111 —112 xd	112⅝	111	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	4½%	20½ — 21	21⅛ — 21⅞ xd	22⅛	21 11/16	..
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	7⅞ — 8⅛	7⅞ — 7¾ xd	..	..	..
1,932,856‖	Commercial Cable Stlng. 500 year 4 % Deb. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 99½	97½ — 99½	99½	98	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	8¼ — 9	8¼ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,961	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼ — 9	8½ — 9¼	..	..	+ ¼
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
66,710‖	Direct United States Cable	20	8½%	8 %	8½%	4½%	15½ — 16½	15¾ — 16 xd	16⅛	16	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	99½ —101½	99½ —101½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	142½ —145½	142 —145 xd	143	142½	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89 — 91	8⅞ — 91	90⅛	89½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	..	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14⅜	14½	14 3/32	..
753,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	106 —108	106 —108	..	..	..
800,000	East & S. Afric. Tel., 4 % Mi. Db., 1 to 8,000, red. 1900	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
200,000‖	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5⅛%	5⅛%	5⅛%	10¾ — 11⅛	10¾ — 11⅛	11	10⅝	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14¾	14⅜ — 14¾	14½	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	38 — 40	39	38⅜	−1
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	4½%	99½ —101½	99½ —101½	90½	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57½ — 59½	58 — 60	59⅞	59½	+ ½
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1/16 — 1/16	1/16 — 1/16	20/-	..	..
72,880	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	1/16 — 1/16	1/16 — 1/16	..	..	..
86,492	Do. do. do. 6 % Pref. ..	1	6 %	6 %	6 %	..	1 — 1	1 — 1	..	..	..
1,993,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	107 —109 xd	108½	107	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	110 —112	107 —109 xd	111½	107⅞	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13 xd	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12 xd	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5½ — 5⅜ xd	5½	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96½ — 98½	97 — 99	98½	98	+ ½
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	104	102½	..
179,313	Oriental Telep. and Elec. 1 to 171,504,fully paid	1	6 %	6¾%	6¾%	7½%	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,339‖	Reuter's	8	5 %	5 %	5 %	5 %	7¾ — 7⅞	7¾ — 7⅞	7⅞	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	..	..	..	..	4½%	100 —103	100 —103	..	..	..
9,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	129½	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6½ — 7	6⅝ — 7⅛	7 3/32	7	+ ⅛
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108 —111	108½ —111½	111	..	+ ½
15,609‖	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9½ — 10	9½ — 10	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	3/16 — 7/16	3/16 — 7/16	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	100 — 103	..	..	+1
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	5 %	14½ — 14⅝	14½ — 14⅝	14⅝	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. — ..	.. — ..	..	..	..
568,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —106	104½	103⅜	+½
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	3/8 — ½	3/8 — ½	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6 — 7	6 — 7	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5½	4½ — 5½	..	..	..
80,000‖	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	6 13/16 — 7 1/16	6 13/16 — 7 1/16	7 1/16	6 13/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝ — 6	6⅛ — 6	6	5 15/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104	102 —104	102½	..	..
800,000	Babcock & Wilcox, 1 to 880,000	1	..	17 %	20 %	20 %	3⅜ — 4	3⅜ — 4	77/6	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3⅜ — 4	3⅜ — 4	75/3	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6⅛	6 — 6⅛	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5 — 5½	5 — 5⅛ xd	5 7/16	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4½	4 — 4½	86/3	..	..
800,000‖	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	116 —119	117 —120	..	..	+1
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	105 —108	105 —108	106½	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103 —105	..	..	..
290,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
188,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	5 7/16	..
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %‖	8¾ — 9¼	8⅝ — 9⅛	9	8⅝	— ⅛
1,415,422‖	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	109 —113	109 —112	111⅜	111	— ½
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	89 — 92	89 — 92	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅜ — 6¾	6⅜ — 6¾	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6 xd	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..	— ⅛
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	3/8 — ½	3/8 — ½	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½ — 2	1½ — 1⅝	..	..	— ⅛
125,000‖	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000‖	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	83¼	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3¼ — 3½	3¼ — 3½	..	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅝ — 5⅜	4⅝ — 5⅜	5⅛	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	101 —104	102 —105	..	..	+1
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8½	8 — 8½	8 7/16	8½	..
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7 15/16 — 8 1/16	7⅞ — 8¼	..	..	+ 3/16
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	102 —104	103 —106	..	..	+1½
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10¼ — 11¼	10¼ — 11¼	10 15/16	10⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 7/16	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	108⅓	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %‖	1/16 — 1/8	1/16 — 1/8	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 29/32 — 1 31/32	1 29/32 — 1 31/32	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	95 —100	..	..	−2
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	85 — 87	86⅞	86	−1
630,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100½	..	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	74⅛	..	..
1,480,000	City and South London Railway	Stock	3½%	3⅝%	3½%	1¾%	42 — 44	45 — 47	46	43	+3
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1½ — 1⅝	1⅞ — 2	..	..	..
100,000‖	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	95 — 98	..	..	+1

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ‖ Interim dividends.
¶ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations July 24th.	Closing Quotations July 31st.	Business done week ended July 31st, 1906.		Rise + or Fall—
		†	1902.	1903.	1904.	1905.			Highest	Lowest.	
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	36/3	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 7/16 — 1 15/16	1 7/16 — 1 15/16	26/3	..	+ 1/8
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13 3/4 — 14 1/2	14 1/4 — 15 1/4 xd	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15 xd	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	95 —100	96 — 98	..	..	— 1/2
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	95 —100	95 — 97	..	..	—1 1/2
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2 3/8 %	..	1 3/8 — 1 1/2	1 1/4 — 1 3/8	..	..	+ 1/8
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2 3/8 %	..	2 1/2 — 3	2 1/2 — 3	..	..	..
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	3/8 — 5/8	3/8 — 5/8	..	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	2 — 2 1/4	1 3/4 — 2 1/4 xd	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	86 — 89 xd	86 — 89	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9 — 9 1/4	9 — 9 1/4	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3	4 %	4 %	3 1/2 — 3 3/4	3 1/2 — 3 3/4	73/9	71/10½	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10 1/2 — 10 3/4	10 — 11	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	101 —102	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	12½	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5½	5¼ — 5½	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	108½	107	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107 —109	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅞	..	..
87,500	‡Liverpool Overhead Railway, Ord.	10	1½%	1½%	1½%	Nil	1¼ — 1⅜	1¼ — 1½	..	..	— 1/16
† 10,000	Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4 — 6	4 — 6½	..	..	+ 1/2
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7 — 9	8 — 8½	8½	..	+ 1/2
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8 — 8¼	8¼ — 8⅜	8½	8	+ 1/2
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	92 — 95	93 — 96	93⅜	93	+1
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	1/8 — 1/4	1/8 — 1/4	2/6	..	..
600,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	16/10½	16/6	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4 7/8 — 5½	4 7/8 — 5½	100/-	97/6	..
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6 3/4 — 7 1/4	6 3/4 — 7 1/4	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32½ — 34½xd	32½ — 34½	33⅜	33	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	92 — 94	90 — 92	..	..	—2
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	3 %	Nil	Nil	1 — 1½	1 — 1½	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2 3/8 — 3 1/2	2 3/8 — 3 1/2	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	79⅛	79⅛	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 5/8 %	5 1/8 — 5 3/8	5 1/8 — 5 3/8	..	..	..
60,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	103½	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 3/4 — 8 1/4	7 3/4 — 8 1/4	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4½ — 4⅝	85/-	80/-	+ 1/2
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4¼	3⅝ — 4¼	..	..	+ 1/2
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4¼	..	..	+ 1/2
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
44,486	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5 1/2 — 5 3/4	5 1/2 — 5 3/4	..	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10 — 10 3/4 xd	10 — 10 3/4	..	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 1/4 — 12 1/4 xd	11 1/4 — 12 1/4	..	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	99—102	100 —103	..	..	+1
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 5/16 — 3 3/8	2 5/16 — 3 3/8	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5 1/4	5 — 5 1/4	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	7 3/4 — 8 3/4	8⅜	..	— 1/2
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11 1/4 — 12 1/4	11 1/4 — 12 1/4	11 13/16	11⅜	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3 — 4	3½ — 3⅝ xd	75/-	68/9	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4 1/2 — 5	4 5/8 — 5 1/4	..	..	+ 1/2
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103 xd	100 —103	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5 1/4 — 5 3/8	5 1/4 — 5 3/8	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5 1/4	5 — 5 1/4	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	99 —102 xd	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	7 3/4 — 8 1/4	7 3/4 — 8 1/4	7 15/16	..	— 1/8
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6 1/8 — 7	6 1/4 — 7	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	99 —101	..	..	+ 1/2
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	99 —101	..	..	+ 1/2
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	10 — 11	9 3/4 — 10 3/4 xd	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	97 —100 xd	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	2	Nil	Nil	3 %	4 %	2 — 2½	2 — 2½	40/-	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5½	5 — 5½	5½	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	98½	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8 — 9	8 — 9	8⅛	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	110⅜	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	94 — 96	94 — 96	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	99¾	99½	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7 3/4 — 8 1/4	7 3/4 — 8 xd	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5 1/4 — 6 1/4	5 3/8 — 6 1/4 xd	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6 3/8 — 6 7/8	6 3/8 — 6 7/8	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	97 — 99 xd	97 — 99	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10½ — 11½	10½ — 11½ xd	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	6 3/4 — 7 3/4 xd	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2 — 2½	2 — 2½	..	..	..
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	74 — 78 xd	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2 3/8 — 3 1/8	2 1/4 — 3	..	..	— 1/4
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	3/4 — 7/8	3/4 — 7/8	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1 3/16 — 1 5/16	1 1/8 — 1 1/8	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 4	3½ — 4	..	..	+ 1/2
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 1/4 — 4 3/4	4 1/4 — 4 3/4	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	12½%	14 %	13 %	10½ — 11½	10 — 11	10⅛	10⅛	— 1/2
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/2 — 5 3/4	5 1/2 — 5 3/4	5 15/32	5 11/32	..

Shares not officially quoted :—Mackay Companies, ord., 76—78. Pref. 74—76.

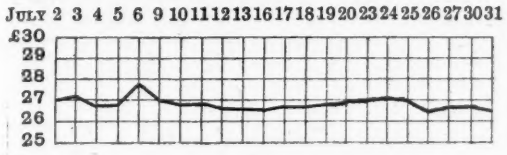
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 3½ per cent. June 21st. 1906).

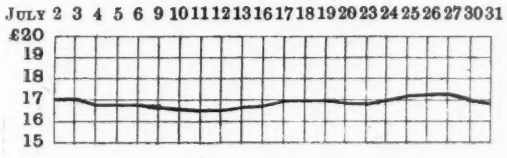
METAL MARKET.

Fluctuations in July.

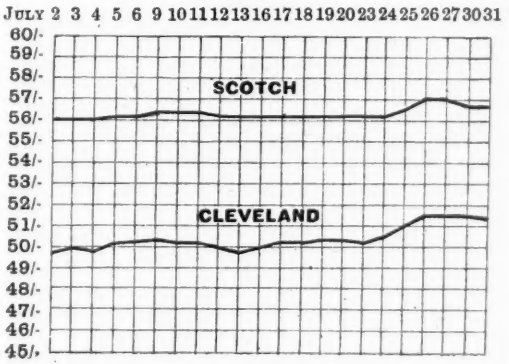
SPELTER (G.O.B's.)



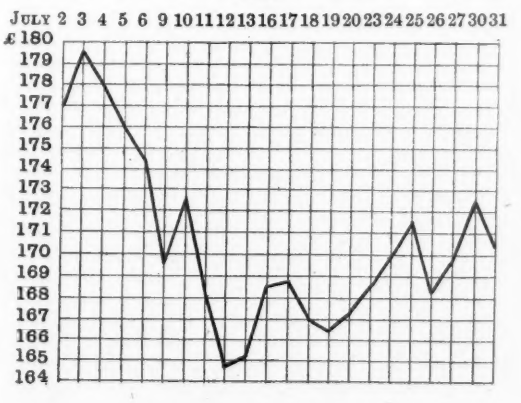
LEAD (ENGLISH)



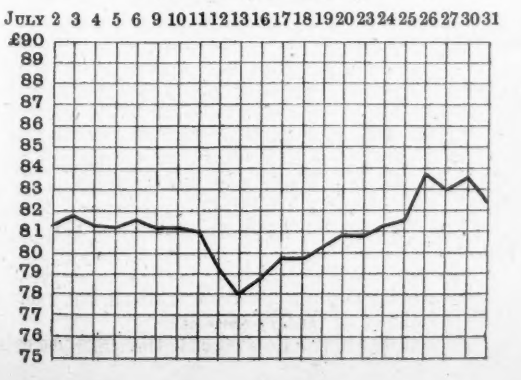
IRON.



TIN.



COPPER (G.M.B's.)



RAIL CORRUGATION: A REVIEW.

(*Concluded from page* 157.)

It is, perhaps, particularly important to note that Fell, Angerer, Ayton and Panton remark the presence of corrugations on rails laid on bridges or elevated structures, Mr. Ayton stating, evidently with knowledge of the facts, that they occur on steam railway bridges, and that on the other hand, Mr. Kaye Butterworth, general manager N.E. Railway, says that no corrugations have been found on the electrified parts of his lines, which are constructed exactly like steam lines and are on the surface. Then the fact noted by the *Electrician* that the Metropolitan District rails are beginning to roar is obvious to everyone who travels over the busiest parts of those lines, although we do not think that they are confined to the stations, and may not be attributable to braking, as suggested by the writer of the note. Perhaps there is some degree of likeness between the latter lines and the elevated lines, some common tendency to resonance, which, when isolated, may help towards the solution of the whole problem.

Meanwhile, we suggest that the committee appointed some years ago by the Municipal Tramways Association should inquire whether anchoring at several points in the length of a rail, or joint welding, gives immunity, and whether corrugations are found on the straight parts of single lines over which cars run in both directions. We should expect, too, that where slipper brakes—or at least metallic slipper brakes—are used constantly, there will be no corrugations, not because they tend to be ground out, but because they do not tend to appear. That will follow, if it is the fact that alternate sliding and rolling of the wheels causes them on lines where wheel-brakes are used solely or chiefly, but it would be a most difficult point to determine, and probably could be ascertained only by ceasing to use slipper brakes for several years, or in an approximate and uncertain way by making careful records of rail wear.

We may now proceed to consider the differences between railway and tramway rolling-stock which might produce waves on the rails of the latter.

Mr. J. E. Stead says (*Light Railway and Tramway Journal*, 1903) that he has no experience of corrugation except on electric lines, and that the cases brought to his notice occurred where the speeds were fairly great and constant, and, he adds, "it does not occur where trams go slower," and would not appear if speeds were not uniform.

His hypothesis is that the phenomenon is the result of car-wheels running at constant speed jumping at the rail-joints and touching the rails again at some definite distance away, the evil growing until a train of depressions is formed. Striking evidence in support of this view comes from Mr. Arnall, Birmingham city engineer (*Electrician*, February 16th, 1906), who shows how constancy in the conditions of construction and the speed of cars has produced persistent corrugations on the rails of that portion of a cable tramway upon which the speed of the cars was in excess of a certain limit.

In that case the speed is much more nearly constant than is ever found on electric tramways, and the cars differ not at all, but it is noteworthy that, although the lines have been in service 18 years, there has been but one very recent and very faint instance of corrugation on that part of the route where the cable runs only 2 miles per hour slower than on that part which is always in trouble.

Clearly the electric car as such has no monopoly in causing this disease; and except for some evidence which has not yet been called, we should feel inclined to say at once that corrugations are not brought into existence by reason of the electrical equipment or the drive.

First, we should like to know whether the Edinburgh and London cable tramways have afforded any evidence similar to that obtained from the Birmingham line. We have ourselves observed signs of corrugation on the Edinburgh track, but we have no precise information as to the conditions under which it was produced. Next, we want to know most keenly if corrugations were or were not observed on any parts of the old steam lines. Mr. Fell says yes, but every-

one else seems to take the contrary for granted. If they were at all common on straight rails we could exonerate the electric car, but if they were not, it might only mean that the speeds were not high enough, or that the engines and cars were of such widely different natures that each neutralised any vibrations set up by the other. The Birmingham example shows excellently how much the speed may be concerned.

If this last hypothesis is sound, it is at least curious that corrugations have not been noticed (we suppose that they have not) on those sections of steam railways where the speed of the ruling traffic is constant, as, for instance, on branch lines served by trains of uniform size, and constructed with rails having low joints cast off from the main lines, or on the Metropolitan and District Railways when they were steam driven. The greater wheel burden of the locomotives ought not to be such a disturbing factor as to cancel the waves made by the coaches. As a general thing, however, steam lines ought not to suffer, as train speeds and weights are so extremely diverse ; while those electric lines which run more than one type of car ought to be affected less than others on which the type is invariable.

Possibly the best proof of this theory will be found on the up-line of a double track on hills which are not so steep as to prevent cars running at fairly high speeds. If cars and equipments are identical, speed will be as nearly constant as can be expected under any practical conditions, and corrugation ought to occur in time.

The Arnall theory involves corrugations over the entire length of the rail, for the cause is independent of the rail, and does not trouble about the rail joints ; but against this theory there is some evidence that the wheels are set dancing by the blow of the low or wide joint, and that the resulting waves die out gradually, not reaching the end of the rail, although we imagine that finally they might extend from end to end. This action would be exaggerated, and may even depend on constancy of speed and similarity in design of cars. At least we can say positively that corrugations by no means necessarily follow low joints, even though the track is thoroughly water-logged for some distance on either side of them.

Most people are agreed that flat curves over which cars run quickly are attacked first, and that the outer rail announces the fact before the inner, and the questions which present themselves are whether corrugations on curves and straight lines are of the same nature, and whether they are produced in the same way. There is no definite written evidence for or against the first, but we take it that any marked difference would have been mentioned before now. As to the second, we incline to think that not everyone who is satisfied as to the cause of waves on curves cares to attribute to it the waves found on the straight.

It is obvious enough that when two rigidly connected wheels of the same diameter are driven round a curve there must be something of the nature of what Mr. Arnall calls torsional vibration, which will affect the rails at some point of speed, but it is not equally clear, unless we accept Mr. Panton's ideas, what produces corrugation on straight rails. He writes in the *Light Railway and Tramway Journal* for May to demonstrate that the origin of the evil is the single gear drive of the standard electric car and of all electric trains since the Central London Railway and the Liverpool Overhead Railway gave up the gearless motors, and the burden of his tale is that corrugations came to the rails on the curves of the latter with the change. The supposition is that the axles are driven on the skew by reason of the gear being at one end of them only, play in axle-boxes and horn-plates permitting, and that this action forces the wheel flanges against the guard-rail or the lip of the groove.

In consequence of this the backs of the flanges are worn, and when speed is attained, the flanges will strike the check intermittently, making the axles oscillate, and causing that intermittent flattening which is called corrugation. That is Mr. Panton's explanation, and considered by itself, it sounds plausible. Logically enough, he is going to prevent the evil by driving from both ends of each axle, so returning as nearly as possible to the old conditions of equally distributed drive under which no corrugations arose.

The American elevated railways are much like our only example, and the drive is single-ended, so the chances are that any particular phenomenon will be common to both, and the origin the same. As we have seen already, corrugations do trouble them, and it will be useful to know whether they occur only where there are check rails against which the flanges can grind.

It occurs to us to point out that the running conditions on the Liverpool Overhead Railway were altered somewhat when the motors were changed. Were not the acceleration, the maximum speed, and the severity of braking increased, and might not these alterations affect the matter directly or indirectly ? For instance, as an example of indirect action, we suggest, quite at random, that the speeds round curves are now nearer the critical speed for vibration than before, and it may be just a coincidence that the speed which the trains or cars attain when the motors are put in parallel, is the speed at which critical vibration would occur, whether the carriages were driven by single or double gears. Mr. Panton thinks that the driving force of the motors in parallel is required before corrugation can be produced on curves. If it can be proved that the same effect is seen on the rails of curves round which cars coast, his theory is demolished.

Many of us have noticed that the *diagonal* flanges of single-geared car wheels often, but not always, wear as Mr. Panton describes, and it is probable that this happens when the route over which the car generally runs is full of curves, but we find it hard at present to accept both the Arnall and the Panton theories, for they seem to be independent when applied to straight rails. Panton's requires a single-gear drive, Arnall's requires no axle drive at all. One makes flange action a necessity, while the other does not ask that there should be any flanges.

If flange action causes corrugation on the straight, the lips of the rails must show it, and no evidence of that has come our way.

Perhaps the strongest objection to the Panton theory lies in Mr. Butterworth's statement quoted above. The N.E. drive is single-ended, and there is as much opportunity for flange action at curves, yet there are no corrugations. The C.L. Railway has been converted to the same drive for long enough to give some idea whether the Liverpool experience is going to be duplicated. If it is not, the Panton theory will receive a serious set-back, and we shall be pointed in the direction of the Angerer theory, which finds the vibration of the whole elevated structure sufficient to account for corrugation, but we are headed off again by the awkward questions, Why did these vibrations produce no effect on the rails of the Liverpool Overhead Railway during the many years of service prior to the introduction of gearing and accelerated service ? and, Why are they not now affected on straight runs ?

How, then, does the braking theory fit ? But ill, for it, too, wants neither flanges nor checks, and its effects, therefore, should be demonstrated upon the rails at and near the stations of the Liverpool Elevated. According to Mr. Panton, "corrugations are only found on electric railways where check-rails are supplied on super-elevated curves." Something authoritative from the Metropolitan and District Railways is much needed, and they should be able to compare the action of steam and electric trains with great advantage to the rest of the world.

Mr. F. T. Aman contributes yet another theory to the *Tramway and Railway World* for July, 1906, based on micro-photographic studies of Liverpool tram-rails. The article should be read as it stands, but the conclusion is as follows :—"A current of electricity flows along the lines of least resistance, and the presence of any undue accumulation of either ingredient [pearlite and ferrite] of the metal must interfere with the uniform conductivity at that particular part of the rail, and when a wheel through which the current is passing comes in contact with a surface segregation local heating is set up, and any consequent softening, however inappreciable, would form the nucleus of a hollow which would soon be hammered into considerable proportions."

It is not a theory for which we can discover any fondness, as it does not satisfy the general conditions, but there may be light in it for all that.

Undoubtedly a small international travelling commission

is the proper instrument to use for the determination of this important matter. As things are at present, it is most difficult to estimate correctly the value of any evidence, simply because every observer is a law unto himself, and is his own check in a great measure. Moreover, the attack in general of individual observers is not wide enough, and is carried out too often with a preconception of the result. A Commission would put its facts, wherever obtained, through the same sieve, whereas scattered observers use the sieves which are at hand, and the chances are that they vary in mesh and in condition.

We have said enough in the course of this review (in which we have tried to be as little critical as possible) to expose the varied aspects of the case, and because of the very serious and universal nature of the trouble, we express the hope that an organised attempt will be made without delay, and without worrying too much about the cost, which will be insignificant in comparison to the growing expense of living in the impotence of ignorance, to put the knowledge of the way to prevent corrugation into the hands of every tramway in the world.

The range of such an inquiry must be very wide, and the time required for the investigation of cases and for the assimilation of results will be long, but a conclusive report would be worth it all.

REVIEWS.

Steam Turbine Engineering. By T. Stevens and H. M. Hobart. London and New York: Whittaker & Co. 1906. Price 21s. net.

For an inspiration, the authors of this volume have acted in the spirit of the insect, a study of whose habits was commended to a certain sluggard. Laborious compilation, combined with systematic arrangement, such as marks this work, have their parallel in the well-ordered method of the commended ant. As a granary of facts marshalled in compartments, and equipped with a good index to facilitate reference, the present volume vindicates the claim of its authors to deal with a field not before covered. For an introduction, we may attempt to explain what the book is not. It is not a mere compilation of patent abstracts. Neither is it the treatise of the designer full of strange formulæ and modern entropy diagrams. Nor does it go to the other extreme and attain to the merits of a handy volume to be read and digested by the leading stoker whom a paternal (or is it grandmotherly ?) Admiralty proposes to place on the footplates of million-pound battleships as engine-room watch keepers.

Having, by a process of elimination, tried to describe what the book is not, it remains to the reviewer to try to indicate what its 800 pages and 510 illustrations are devoted to. It is an attempt to deal with the question from the point of view of the purchaser and user. Therefore, it is not merely confined to questions of steam consumption, but also to first cost and to maintenance. To aid the prospective purchaser, and prospective or present user to whom the book is equally, if not more, useful, comparisons are furnished between steam turbines and reciprocating steam engines. Information has, therefore, been collected from turbine and reciprocating engine makers, while the proceedings of seven societies have been indented upon. Much information has also been culled (in each case with due acknowledgment) from the pages of the Electrical Review, and also from the pages of our leading contemporaries, British, American and German.

The atmosphere of commercialism confronts us in the first or introductory chapter. The way to the purchaser's order department being through an appeal to his pocket, prices are given with a discussion as to the respective capital outlays on reciprocating and turbine sets varying in size from 65 kw. to 1,500 kw., and including the estimate for a 90,000-kw. turbine plant, suggested when the Administrative County of London (&c.) Co.'s Power Bill was before Parliament last year. The relative capital cost of condensing equipments receives very interesting treatment. For instance, taking the cost of laying down a plant to maintain a 26-in. vacuum as equalling 100, the cost of a 27-in. vacuum becomes 133, the cost of a 28-in. vacuum 160, and the cost of a 28½-in. vacuum 200. Peripheral speeds, pressures on bearings, numbers of vanes, and so forth, are given for machines of various outputs.

The second chapter deals with nomenclature. The authors begin by urging the use of the kilogram-calorie in place of the B.Th.U. as more scientific, and express the hope "that it will ultimately find its way into English technical literature, and, endowed with some satisfactory name, become the universal practical unit of energy." Our own view of this side issue is that it is not the name that debars its use, but the fact that many engineers who use metric measurements are apt to think in English units of measurement. For the rest, this chapter is replete with tables of equivalents of weight, length, pressure, area and speed.

Chapter III is devoted to the familiar De Laval turbine, and deals with efficiencies and consumptions at various percentages of the rated outputs. The tables are lengthy and rather cumbersome. Chapter IV is the best compiled in the whole book. Part of this is perhaps due to the fact that more is known of the Parsons turbine than of any other pattern. Commencing with line drawings and photographs of one or two typical installations, we come to a very valuable series of curves, which are mainly based on the admirable records of various installations given in Tables XXXVI and XXXVII. These curves show at a glance the effect on steam consumption at different loads of varying the steam pressure for turbines of different sizes, and the results of varying the vacuum and varying the superheat. In regard to the last named, fig. 120 will be specially valuable to engineers wishing to correct the steam consumptions obtained on test for variations in superheat above or below that specified.

The fifth chapter, on Curtis turbines, is naturally shorter than its predecessor, although its descriptions of structural detail are every bit as lucid. Interesting curves are again given showing consumptions at various loads. Apparently the effects of varying superheat and vacuum have yet to be studied for this type.

Succeeding chapters deal with the Rateau, Zoelly, Riedler-Stumpf, A.E.G., Hamilton-Holzwarth, Elektra and Union turbines. These chapters are mainly descriptive, information as to steam consumption and the factors which affect it being sparse. Were it not for the repute of some of their makers, the reviewer would be tempted to compare them with certain chapters in 80 and 90-year-old books on the steam engine, where illustrations and descriptions of experimental engines are the only memorials left to the ingenuity of their inventors. Engineering science now stands in a different category, so that the comparison would scarcely be a fair one.

Chapter XIII is devoted to "a recapitulation of the properties of steam," the properties being expressed in English and metric units. Chapter XIV, on the calorific value of fuels, seems to be the only one out of place and harmony with its neighbours.

Chapters XV and XVI are worth very careful study. Four representative firms of engine builders, designated as A, B, C and D, furnished particulars of the guaranteed steam consumptions of their piston engines. Reducing the various tests of representative piston engines and turbines to the standard conditions of a pressure of 13 kilogrammes per square centimetre, 50° C. superheat, and a 26-in. vacuum (or 86·6 per cent. of a barometer standing at 30 in.), the consumptions are given for full, half and quarter load. At full and half-load, according to the authors' curves, piston engines have the advantage up to 3,000 kw., while at quarter-load the advantage lies with the reciprocating engine all through the curve which runs to 5,200 kw. Other curves show how these comparative results are modified with 28 in. vacuum and other steam pressures. We believe that this valuable chapter will give an answer once for all to the vexed question of consumptions under different conditions. We hope that, before interested disputants compare unlike engines under unlike circumstances, they will peruse these pages. Such a perusal, although it may detract from the attractive vigour of controversy, will save much time.

The remaining chapters are mainly encyclopædic. We find in them practically a census of everything connected with turbines, from details of condensers and tabulated descriptions of stations down to tabulated accounts of the equipment of turbine-driven vessels and a complete bibliography of turbine matters. The illustrations throughout the book, both line and half-tone, are beyond reproach. It is hardly necessary to add that we have formed a most favourable opinion of this excellent work.

LIGHT—COLOUR—VALUE.

THERE have been many discussions lately in the technical Press and elsewhere on the subject of light, the relative value of gas and electricity, the proposed standardisation of electric lamps, &c., and I have been much struck by the absence of any exactness or definiteness as to what light should be. In nearly all these discussions the value of light is regarded on the basis of the quantity or intensity only of the light given by each illuminant, the quality being always ignored or dealt with in quite a cursory manner. The efficiency of electric incandescent lamps, "open," "enclosed" and "flame" arc lamps, Nernst and mercury vapour lamps are all discussed in similarly unsatisfactory style.

Surely it is possible to determine what is useful light, and to obtain an authoritative dictum as to what is best suited for the human eye.

It is commonly stated that what we want is white light, and each lamp merchant claims to have produced a counterfeit of or improvement on the sun. White light is, of course, a compound, and what we want is an authoritative decision as to which primary colour or combination of primary colours is required for human use. I was surprised to hear Mr. Swinburne say at the Electrical Exhibition that probably the best quality of light for home use would be obtained from numerous coal fires dotted about our rooms, but that it would be the most costly. Well, the best generally is the most costly, and the practical man was created especially for the purpose of finding the nearest approach to the desirable at a practicable price. It is no use saying that you can get larger quantities of green or blue or yellow light at a cheaper price, though, of course, if you get enough bad light, it will serve after a fashion, as there will be enough red light contained therein to enable you to see; and, in my opinion, it is the use of glaring lights of improper colour that occasionally punishes the eyes so by reason of the fierce reflection from all white surfaces, and makes one wish for two or three tallow candles for a treat. Therefore, neither quantity nor quality must be neglected when comparing values.

I say I was surprised to hear Mr. Swinburne say that light ought to be red. I always thought so, but did not think it was scientifically settled that way. I was surprised again when he discussed the mercury lamp, and said that as it was so deficient in red rays, it was very restful to the eyes. This, I think, can only be true in a certain sense. If you give up trying to work or read by it, of course it is restful, but you can do this to still better effect, probably, in total darkness.

In regard to the useful life of incandescent electric lamps, it is often stated to be best to over-run them, getting a largely increased quantity of light for a shorter life, and recent tests show that (on a quantitative basis only) this will pay when lamps are over-volted to an extent that will correspond with a consumption of power of 1·5 watts per candle-power. All this I fervently disbelieve. The light is much too "white," *i.e.*, deficient in red rays, approaching the colour of the "highly efficient" open arc lamp, and suitable only for open-air treatment and for decorative purposes. The matter then resolves itself mainly, I believe, into a determination of the correct degree of incandescence permissible, and it would appear that nearly all materials are capable of being raised to such a temperature that the emitted light is useless for lighting purposes. If you hustle sufficient gas through a burner by compression you can get enough light from a "Welsbach" to frighten the most hardened electrician. Whether the extra cost of gas and mantles is "worth the candle" is what I want to know. My belief is that the effect is precisely the same as the over-volted incandescent electric lamp and some arc lamps, the light being decorative but useless.

Standardisation and comparison of lights then should start with a determination by spectrum analysis of the constitution of the light emitted by the incandescence of each material, and this I am confident would lead to the immediate rejection of many lights that are now in use to the detriment of our eyesight. Incidentally, I think we should arrive at a more satisfactory understanding of the relative values of electricity and gas. R. G. T.

A NEW TYPE OF CONDENSER.

WE recently inspected two condensing plants at the Electrical Works, Wallasey, Liverpool, which present some novel features of sufficient interest to put prominently before our readers.

One condensing plant deals with 40,000 lb. of steam per hour, while a smaller one condenses 15,000 lb. per hour. Both sets are quite new and have been constructed and installed by the Hudson Economiser Co., Ltd., 30, Spring Gardens, Manchester, under the Hudson-Holehouse patent.

The principle is simply as follows: The exhaust steam from the engine is led into one end of the condenser, which consists of a large wrought-iron chamber, cylindrical in shape, and divided inside by baffle plates into three separate portions. The steam, on entering the first chamber, which is of large volume, has its velocity impeded, and consequently all the oil, grease and other impurities fall to the bottom of the chamber and are led away to a small grease pump or settling tank. The steam then passes upwards and circulates round the next chamber. Into this chamber the feed-water is led by a separate pipe (the water meets the steam, and is raised up to the same temperature, while impurities present fall to the bottom of the chamber), while from this chamber to the feed pumps is a connecting pipe, which ensures a very high temperature of the feed water.

After being purified, the steam passes to another chamber, where it meets a current of water entering in the opposite direction, and is condensed.

A wing valve in the injection pipe is regulated by a float and levers, so that the water level in the condenser is kept constant. The whole of the water is taken away by a water pump from the bottom of the condenser chamber, while a dry-air pump takes away the air from the top.

In the smaller set, the air and water pumps are of the vertical steam-driven type provided with a centre-weight governor driven by gearing, while in the larger set both pumps are of the horizontal type, the water pumps being of the plunger pattern, and the air-pumps of the ordinary type with valves at each end of the barrel. The water pumps discharge into cooling towers, and on being cooled the water is drawn up again by suction due to the vacuum into the condenser, which process constantly recurs. By this means the water required for condensation is reduced to a minimum.

A vacuum of 27·5 in. is steadily maintained under a variable load of traction and lighting.

Under these conditions the feed water is kept at a temperature of 100° F., very free from grease and reduced from 25 degrees to 12 degrees of hardness.

The cooling towers are rather small, as they have not been enlarged to meet the requirements of the new condensing plant; the results, however, are sufficiently good to show that this type of condenser is a distinct advance on the ordinary jet or surface type, the more so, since to all intents and purposes it comprises a grease separator and a feed-water heater, and takes up less floor space than is required by other types.

The condenser is particularly suitable for use in connection with steam turbines, as a high vacuum is maintained through great and sudden variations of load, and a very large volume of steam can be dealt with.

That the condenser gives satisfaction, is shown by the fact that the larger set was ordered after an exhaustive trial of the smaller.

BOWELL'S ELECTRIC CLOCKS.

ELECTRIC clock systems, consisting of one "master clock" arranged to close a circuit periodically (generally every half-minute or every minute) for the purpose of actuating any number of "indicating dials," have been favourite problems for many years, and have met with more or less success, though they have not reached the stage of general adoption.

To some extent, the failure of the public to appreciate the advantages of electric clocks has been due to the fact that they have not been as silent in their action as is desirable, also reliability has not been a distinguishing feature of their working. Any attempts, therefore, which are made, on true mechanical principles, to ensure success, are well worthy of note.

The G. B. Bowell system obtains, with the aid of extremely simple and well-designed mechanism, the advantages which one

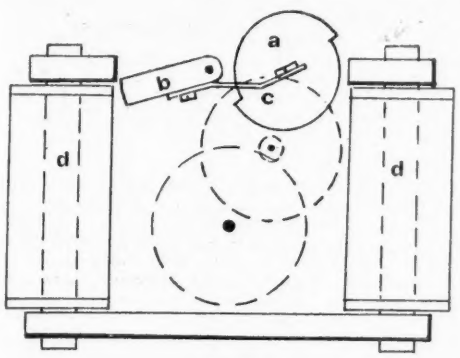


FIG. 1.

would naturally expect to follow upon the use of electro-magnetic apparatus in which the work to be done (at each half-minute) is spread over a comparatively long space of time.

This system, which possesses distinctly novel features, works silently, although all the working parts are metal to metal, and it works (it is claimed) with a current sufficiently small to enable an ordinary wet Leclanché battery to give a thoroughly satisfactory life, and with a reasonably small variation in current during that life. Apart from this latter consideration, an important feature with this system is that the minimum working current may be greatly exceeded without giving rise to undue wear and tear of the mechanism and without producing noisy action.

Figs. 1 and 2 show the action of the Bowell system; fig. 1 being a diagrammatic sketch of the receiver movement, and fig. 2 that of the transmitting contact in the master clock. In fig. 1 a rotary armature *a* is arranged in conjunction with a reciprocating armature *b*, these being arranged tandem in the field of the electro-magnet *d*, the armature *a*, when acted upon by the electro-magnet would

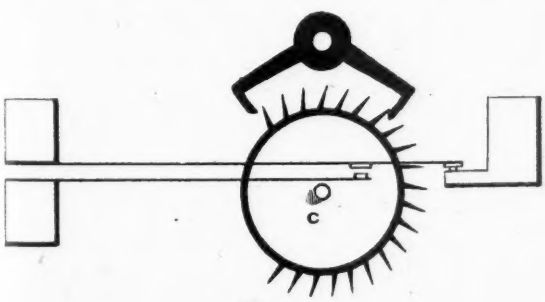


FIG. 2.

rotate not quite half a revolution, and the armature *b*, with its lever *c*, is therefore provided for the double purpose of completing the exact half revolution of *a* upon cessation of the master clock's signal, and of holding the parts normally in the position shown.

The movement of armature *a* is conveyed to the clock hands by gearing. It will be noticed that there are no springs nor delicate adjustments, that no part is reciprocated except the armature *b* and its lever; and that this lever, owing to the manner in which the two armatures assist each other, never appreciably leaves contact from the surfaces upon which it acts, so that a silent action is always ensured.

There is a very considerable torque upon the arbor of armature *a* even with a small current, and as this arbor is geared down in the ratio of 1 : 60 to the minute hand's arbor, there is ample power available for the movement of the hands, &c., under all ordinary conditions.

The master clock has its transmitting contact operated in a very simple and substantial manner, which, we believe, is distinctly novel and is decidedly good. Fig. 2 shows the escapement which has some of the teeth omitted from the scape wheel, this results in a long run for the purpose of allowing the cam *c* to operate the contact springs at the completion of each half minute. The ordinary run, or "drop," taken by the scape wheel after the finish of an impulse is kept as small as conveniently possible, because no useful result is obtained for it, but whether the drop is long or short, it does not affect the impulse either before it or following it. The contact arrangement is provided with additional contacts, as shown in the illustration. When the battery circuit is closed, these additional contacts cut out the non-inductive shunt; but as the shunt cannot fail to be connected the instant before the battery circuit is broken, this arrangement results in a perfectly sparkless action. It is hardly necessary to add that the contact springs are in this way actuated by plenty of power by the cam *c*, so that the whole mechanism can, in common also with the receiving device, properly be described as containing nothing more delicate than the time-honoured "grandfather clock."

THE VALUE OF THE REHEATER IN COMPOUND ENGINES.

[COMMUNICATED.]

MR. E. G. HILLER'S paper, read before the Institution of Mechanical Engineers in July of 1904, gave the results of very careful tests undertaken with a view to determining the efficiency of a 1,200-H.P. horizontal compound engine, and is worthy of comment and commendation. The special value of this exhaustive contribution lay in its bearing on the vexed question of the commercial value of reheaters, although the paper as a whole was one which might well be adopted as the standard for all engine tests. The engine which formed the subject of the tests, made 65 revolutions per minute, and worked with superheated steam at 155 lb. pressure per square inch at a temperature of 441° F. to 450° F. The cylinders and reheater were both unjacketed, but covered with a non-conducting composition. During the tests the average indicated horse-power was 980, and the mean steam consumption obtained by measuring the water fed into the boiler was 11·3 lb. per I.H.P.-hour. With the reheater in use the steam consumption was 0·51 lb. less than when the reheater was not used. The use and non-use of the reheater considerably affected the relative outputs of the two cylinders. When the engine was working with steam in the reheater, the power in the high-pressure cylinder exceeded that in the low-pressure cylinder by about 17 H.P. On the subsequent test with the reheater out of use, the high-pressure cylinder developed about 103 H.P. more than the low-pressure cylinder, being about 44 H.P. increase on its previous load. Assuming that the point of high-pressure cut-off remained the same with the reheater in use as without the reheater, then under the latter condition, owing to condensation, a less quantity of steam would enter the low-pressure cylinder, and less power would be developed in that cylinder than with the reheater. That is to say, the reheater substantially increases the available power of the engine.

The thermal efficiency of the engine was in all ways creditable. Taking the specific heat of superheated steam at 0·60, the heat supplied per minute per I.H.P. was 217·0 B.TH.U. with the reheater in use, and 229·5 B.TH.U. when working without the reheater. Similarly the efficiency ratios, contrasting these performances with those of the standard engine of comparison (Rankine Cycle) are 0·70 with the reheater and 0·667 without.

An examination of the financial aspect shows results favourable to the reheater:—

"It is calculated, after making all due allowances, that the coal saving effected per year, assuming that the engine works with the same load as at the test, is about 67 tons. The engine was, however, designed for a load of 1,200 H.P. Calculated on this basis, the saving effected per year is about 85 tons. The price of coal at the mill is 16s. per ton, so that the annual saving will be about £70 with the load at 1,200 H.P. The cost of the reheater over that of the usual connecting pipe between the cylinders, taking into account the extra cost of carriage and erection of the reheater, is estimated by the makers at £226. The above savings, therefore, represent the annual return on the initial cost of 24 per cent. when the engine is working at 980 H.P., and of 30 per cent. when the engine is working at the power for which it is designed. Allowing 12½ per cent. for interest on the capital, depreciation of plant and attention, the respective annual savings are £25 and £40 per annum."

So much for the modern reheater using superheated steam for drying the steam between the high and low-pressure cylinders of a compound engine. Compared with the use of ordinary saturated steam, described in an earlier paper by Prof. Weighton, the results are very gratifying. The use of steam in any form in a reheater spells the consumption of fuel on the fire bars, and the only point in a well-designed steam-driven plant in regard to which there is any possibility of recovering any of the heat wastes—binary fluid engines excluded—is in regard to the waste gases. The reclamation of this waste by means of superheaters and economisers has left us in a normal case with flue gases of a temperature of 480° F., containing about 12 per cent. of the heat originally present in the coal. In the low pressure cylinder of compound or triple-expansion engines, the initial pressure of the steam being about 20 lb. absolute, the initial temperature is 230° F., or about 250° below that of the flue

gases. It is perhaps a debatable proposition that for the purpose of securing slight further savings these gases, which in temperature are equal to steam at 150 lb. pressure, with 112° F. of superheat, should be used for the purpose of drying the low pressure steam. Experiments along these lines might result in the securing of a small saving, as it would only be necessary to dry the steam, or at most to give it the slight superheat of 5° to 10° F. The experiments would be difficult to conduct in any supply station not specially designed for the purpose. Either the steam would have to be carried to a low pressure superheater, with radiation losses and friction *en route*, or a portion of the flue gases would have to circulate through the reheater, this circulation being forced by a fan. These gases being returned to the smoke stack at a fairly high velocity would tend to improve the draught. The chief objection which seems likely to arise would be the difficulty of cleaning the by-pass flue to and from the reheater, and the tubes within the reheater itself.

RECENT ELECTRIC PYROMETER APPLICATIONS.

The field of usefulness of the electric pyrometer is constantly growing broader. Electricity plays an important part in the industrial measurement of high temperatures, aside from its value as a research agent. The resistance thermometer, the thermo-couple and the radiation pyrometer now offer means of measuring temperatures which could only be approximately determined, if at all, a few years ago, and apparatus is now on the market which will indicate or record temperatures as high as 7,800° C. In other words, the temperature of the sun has been electrically measured. The temperature of the electric arc has been found to be 3,760° C. by Mr. Féry, and it would be hopeless in any electric arc furnace to attempt to measure the temperature by means of any pyrometer not based on the effects of radiation. In blast furnaces, brick kilns, open-hearth steel furnaces, porcelain kilns and glass melting furnaces, the temperatures are either so high or the nature of the gases and furnace products so destructive that ordinary pyrometers cannot well be employed.

The day has passed when the element of chance, so conspicuous and so costly in many processes, will suffice in important industrial operations requiring the use of great heat for their successful issue. It is interesting to note the adaptability of electricity to the difficult heat measurements which play so important a part in many industries. Thus, in chemical works, the processes in which electric thermometers may be used are almost innumerable. They can be used to control the temperature of vats, stills and furnaces, and in a general way the measurement may be made within an error of one-half of 1 per cent. Equally important is the control of the temperature of annealing furnaces. Without some sort of pyrometer in such work there is excellent prospect of ruining the castings or stampings under treatment. With a recording attachment the electrical thermometer preserves a complete record of the temperature variations in the furnace during the time the product is under treatment; it shows the effect of each firing and gives a check upon the relative efficiencies of the firemen.

In the hardening furnaces for treating high-speed tool steel, it has been found that at the hardening point 1° C. makes a noticeable difference in the resulting steel quality, and 5° make the difference between good and bad hardening. The efficiency of a dust destructor depends largely upon the temperature maintained, and by means of an installation of electric thermometers carefully distributed about a steam plant, the efficiency of boilers, superheaters and pressure gauges can constantly be watched. The temperature of the flue gases and of steam in the piping system is worth studying from time to time also, and if desired, continuous records can be obtained at the main switchboard of all these temperature variations by electrical means. Still another interesting application occurs in cold storage warehouses. In some cases men are employed to read the temperatures of the various rooms, and this entails the opening and closing of a large number of doors, which, in addition to the labour cost, is wasteful of power and tends to destroy the uniformity of the temperature in the various rooms. At the plant of the Cardiff Pure Ice and Cold Storage Co., Ltd., in which 34 Cambridge thermometers were installed, the engineer reads the temperature of all the rooms in 10 minutes. Before the electric thermometers were installed the operation required 55 minutes, so that the daily saving, with readings every three hours, is six hours. The maintenance of an even temperature in hospital wards is greatly facilitated by electric thermometers focussed on the engine room indicators. Still other uses are in connection with galvanising baths, in explosive stores, magazines on shipboard, in coal pockets, timber stores, and in the determination of melting points.

The resistance thermometer has the advantage of high accuracy and a wide range, but is more expensive than the thermo-couple thermometer, which is specially suited to work where there is great risk of the instrument's destruction. The latter type is, however, not as sensitive as the resistance thermometer, and requires more frequent standardising. The radiation type has the great advantage of not coming in contact with the bodies at high temperatures which it measures, and it is therefore specially suited to the most difficult measurements of the higher thermal ranges. With Prof. Féry's instrument, the only restriction is that the body observed must not be too minute. With this type of apparatus, the condition of hot metal in the foundry can be followed with great accuracy. The precision which has been attained in pyrometric applications is very largely due to the facility with which electricity may be employed in delicate work on a commercial scale.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Reyrolle Apparatus.

In fig. 1 we show a new form of motor starter panel, which is being introduced by Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne. It is a combination of their standard lever type starter with a "Berry" type "push and pull" switch fuse, and has been designed to meet the requirements of power users, supply companies, contractors, and motor manufacturers, who need to purchase at once a complete panel which will contain all that is required for the manipulation and erection of a motor circuit. The panels are made with or without the ammeter or H.P. indicator (our illustration shows the former type). It appears to be a sound and

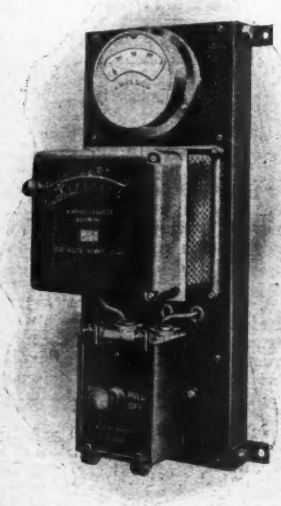


Fig. 1.

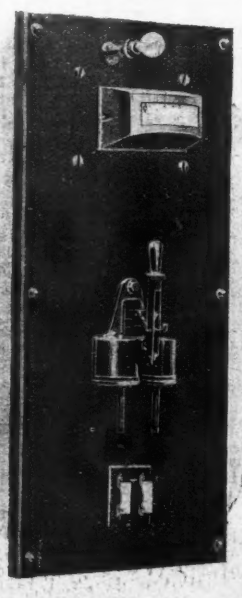


Fig. 2.—Three-Phase Panel with Overload Release.

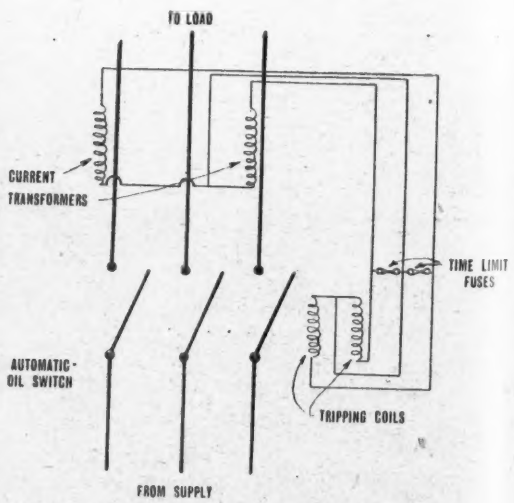


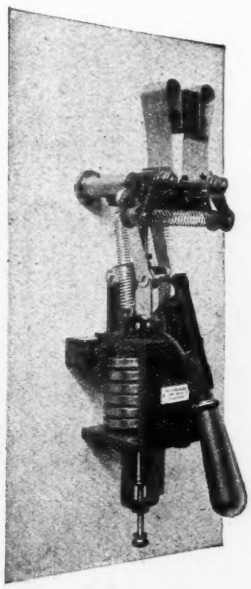
Fig. 3.—Diagram of Reyrolle Time-limit Circuit-Breaker.

mechanical apparatus, strong enough to stand the roughest treatment. The starter contains the firm's special resistance by the use of which it is possible to start the motor while the lever of the starter is held at the first stud. This resistance also has the attractive feature that it contains no resistance wires to fuse or break, and sparking on the studs becomes eliminated. The "push and pull" switch is claimed to be fool-proof and is designed so that it will not stop in any intermediate position between "on" and "off." It has a rapid make and break and it is impossible to make circuit by closing the cover; on the other hand, the cover cannot be opened without first pulling the switch to the "off" position. The three appliances are coupled together and mounted upon a strong angle iron frame. It is suggested that the combination saves a good deal of trouble in purchasing departments, and also avoids delay and waste of labour which would be incurred if the several appliances were purchased from different quarters and assembled together by the user or the contractor on the consumer's premises.

Another device of Messrs. Reyrolle's is their time limit overload device for three-phase circuits. The rapid growth in the use of three-phase power plant gives rise to a demand for the standardisation of switch panels controlling such circuits. A very usual form of panel for this purpose is of the type illustrated in fig. 2, which includes a glow lamp to indicate whether the panel is alive, an ammeter, and an automatic three-phase oil break switch, operated by a handle from the front and automatically by a solenoid tripping device. The novelty, however, of this panel lies in the simple arrangement for adding a time element action to the automatic gear. The connections of this apparatus appear in fig. 3 where it will be seen that a small fuse is inserted in parallel with each tripping coil of the switch, or, in other words, the tripping coils are shunt connected across the fuse. Simplicity and flexibility are claimed as its merits. The size of the fuse may be varied to adjust the amount of overload at which the circuit is to be isolated, and by varying the material used on the fuse, a long or short time element may be obtained.

Improved Circuit Breaker.

The accompanying illustration shows an improved circuit breaker which is being made by Messrs. Lionel Robinson & Co., Ltd., of Thames Ditton, for sizes up to 1,500 amperes. It is a modified form of their older type which has been found so successful. The chief improvements are in the way of simplicity of design and less space occupied. The carbon break is now mounted on an extension of the main contacts, and stands well away from the board; it is actuated by a patented arrangement of inclined planes, thus doing away with link motions. The trigger mechanism is easily seen in the illustration, and is of very simple design. The handle, as shown, is independent, so that there is no movement when the breaker opens. This feature enables the gear to comply with the requirements of the Home Office for the use of electricity in mines. A small and cheap addition to the handle-arm provides the unclosable feature by which the circuit breaker cannot be closed on an overload. The switch movements, which are finely laminated, are parallel to the board, and are such that strain and shock are reduced to a minimum, allowing of the use of thin panels. The fact that the switch does not fall away from the board, and so become liable to hit an attendant, will be readily appreciated. The carbon break is very wide, and on leaving the arc horizontal, the latter flies up and dissipates itself instantaneously, even on a dead short circuit. The space occupied is small, the overall dimensions being only 20 in. × 9 in. A patented adjustable time-element can be attached if desired.

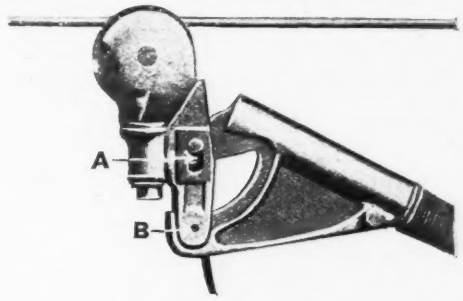


Robinson's Improved Circuit-Breaker.

The Latest Trolley Head.

The accompanying illustrations will give a clear idea of the ingenious invention of Messrs. Holmes & Allen. Personally, we should have wished that they had sought rather to perfect the retrieving trolley pole, but as they have chosen otherwise, we can say no less than that their device for preventing the mischief which happens continually with the usual swivel head has most things in its favour. We have not seen it in action, but so far as we can judge from the photographs, it compares favourably with any head of its kind on the market. Its simplicity and strength are especially noticeable, and there is no doubt in our minds that its action is certain.

Fig. 1.—Trolley Head in Running Position.



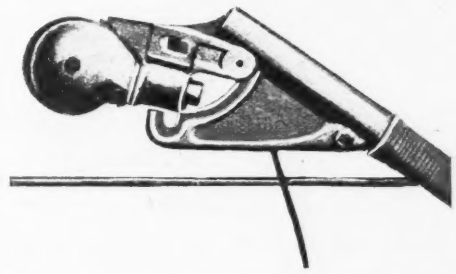
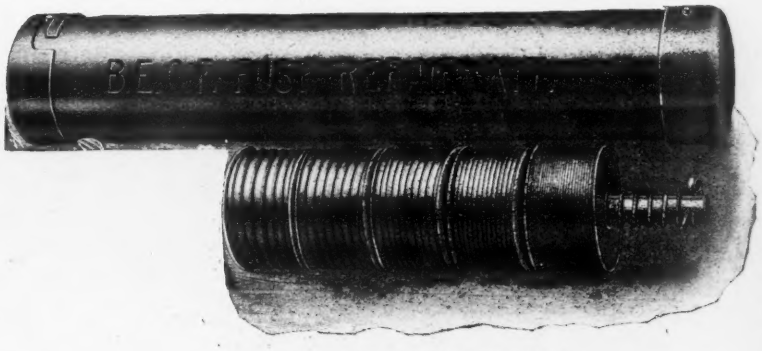


Fig. 2.—Showing Position after leaving Wire.

All that is necessary to make the illustrations quite clear is to say that pins A and B are connected by a spring in tension, and that the head is reset by pulling the trolley rope. Whenever the wheel is not in contact with the wire, the head is in the safety position. It is claimed for the spring that it has the effect of cushioning the blow of the wheel against the leading end of certain forms of ears which are still very prevalent.

Calibrated Fuses.

The British Electric Calibrated Fusé Co., of 14, Golden Lane, E.C., have recently issued an illustrated catalogue on fuses, &c. They are making a speciality of this one branch of the business, and we understand that they have just had to enlarge their works considerably to cope with the increasing demand for these goods. One of their main specialities is "Pyrotin fuse wire," which is claimed to be better than tin, and yet cheaper. This wire is made at the company's works in Harpenden by a patent process, and is wound on metal reels and packed in metal boxes containing 1 lb. each; in this form it is handy for the wireman's toolbag. The firm make a complete fuse repair kit, consisting of an assortment of different size fuse wires, on separate reels, stamped with the current rating, and packed in a polished aluminium case, making a compact and useful kit. Every type of Mordey enclosed fuse is made at the Harpenden works.



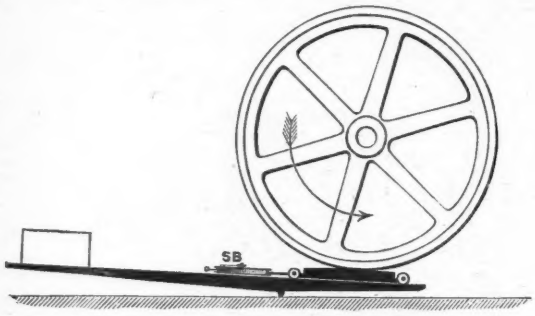
Fuse Repair Kit.

Their open type fuses are made on the divided wire principle, so bringing the working limits very close together, the heat factor being practically constant. They have a magazine fuse for fitting to ordinary distribution boards, which contains a reel of the correct size wire at the end of the porcelain, which can replace the fused wire in an instant. This reel contains 50 replacements. These magazine fuses can be obtained separately to fit to existing boards, or with the boards complete.

The firm are also supplying a flexible arm electric light fitting. By sending a card to the London office, anyone interested can obtain a copy of the catalogue.

The Sellers Dynamometer.

To overcome the difficulties usually attending the measurement of brake horse-power, an ingenious device has been patented by Mr. F. Sellers, of 8, Muswell Road, Muswell Hill, N. It consists of a lever, on one end of which is a wooden brake block running on small flanged wheels, and attached to a spring balance (S B in figure). The lever is placed under the pulley as shown, with the block pressing against the rim of the pulley and the fulcrum resting



Sellers Friction Dynamometer.

on the floor. The load is applied by laying any weight on the long end of the lever, and is adjusted by sliding the weight along it, while the spring balance registers the force applied to the rim of the pulley. The formula is

$$\text{B.H.P.} = W \times S \div 33{,}000,$$

where W = the reading on the balance in lb.,
and S = the peripheral speed of the pulley in feet per minute.

The friction of the wheels of the brake block is found to have no appreciable influence on the readings. The idea is certainly clever, and the device will doubtless become very popular.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,782A. "Improvements in and connected with electric motor-generators." H. Leitner. (Date applied for under Rule 5 of the Patents Rules, 1905, June 15th, 1906.) July 20th.

16,011. "Instrument for observing and recording the instantaneous voltage across two points, or the instantaneous current flowing in, or the instantaneous power given to a circuit." J. T. Irwin. July 16th.

16,066. "Improvements in rests for telephone receivers." R. W. Coan. July 16th.

16,087. "Improved apparatus for regulating the speed of single and polyphase induction motors." A. Scherbius. (Date applied for under Patents Act, 1901, July 18th, 1905, being date of application in Germany.) July 16th. (Complete.)

16,093. "Improvements in speed indicators." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 16th.

16,120. "Electric shock protectors." C. E. Hollier. July 17th.

16,159. "Improved electric battery zinc." H. Rollet. July 17th.

16,160. "Improvements in electric arc lamps." The Jandus Arc Lamp and Electric Co., Ltd., and A. D. Jones. July 17th.

16,161. "Improvements in electric arc lamps." The Jandus Arc Lamp and Electric Co., Ltd., and A. D. Jones. July 17th.

16,162. "Improvements in electric arc lamps." The Jandus Arc Lamp and Electric Co., Ltd., A. D. Jones and B. M. Drake. July 17th.

16,166. "Improvements in magnetic brakes for tramcars or like vehicles." J. W. Martin. July 17th.

16,176. "Improvements in apparatus for administering hydro-electric baths." G. A. Knothe. July 17th. (Complete.)

16,195. "Improvements in overload protective devices especially applicable to the control of electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 17th.

16,204. "Improved globe attachment for electric glow lamps." G. Davis. July 18th.

16,227. "Improved means for suspending the anodes and cathodes of electrolytic baths." F. A. Glover. July 18th.

16,247. "Improvements relating to systems of electrical distribution." M. Walker. July 18th.

16,248. "Improved method and apparatus for gauging temperatures." F. L. Morse. July 18th.

16,263. "Improved automatic switch for use in installations for electrically lighting railway trains." H. Wright. July 18th. (Complete.)

16,269. "Improvements relating to electric induction furnaces." The Grondal Kjellin Co., Ltd., and J. Harden. July 18th. (Complete.)

16,314. "Improvements in or relating to terminals of electrical machinery or apparatus." J. T. Westwood and W. L. Jones. July 19th.

16,342. "Improvements in magnetic control appliances." Stothert & Pitt, Ltd., and C. R. Heath. July 19th.

16,357. "Improvements in direct-current dynamo-electric machines. Elektrizitats Actien-Ges. vorm. W. Lahmeyer & Co. (Date applied for under Patents Act, 1901, July 20th, 1905, being date of application in Germany.) July 19th. (Complete.)

16,359. "Improvements in and relating to electro-magnetic switches operated by alternating current." Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, July 19th, 1905, being date of application in Germany.) July 19th. (Complete.)

16,361. "Improvements in electric circuit controlling devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 19th.

16,396. "Automatic electric fire alarm." W. G. Meddings. (Date applied for under Patents Act, 1901, October 10th, 1905, being date of application in New Zealand.) July 20th. (Complete.)

16,410. "Improvements in enclosed electric arc lamps." J. Brockie. July 20th. (Complete.)

16,425. "Improvements in and relating to apparatus for laying electric conductors and the like." E. C. R. Marks. (A. Boström, Sweden.) July 20th. (Complete.)

16,456. "Improvements in electrically-illuminated mirrors." E. P. Hides and H. Burrell. July 21st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Multiplex Telegraph Systems. T. Giara. 11,685. June 3rd.

Wireless Telegraphic Apparatus. A. Artom. 13,464. June 29th.

Electric Ignition Device or Sparking Plug for Internal Combustion Motors. C. O. Bastian and G. Calvert. 13,563. July 1st.

Telegraphic Systems. P. Picard. 13,605. July 1st. (Date applied for under International Convention, December 27th, 1904.)

Armatures for Magneto-Electrical Machines or Electric Dynamos or Motors. F. Saldana. 13,794. July 4th. (Date applied for under International Convention, July 5th, 1904.)

Electrical Signalling and Controlling Devices for Railways. L. Kottmair and R. Zwack. 13,796. July 4th.

Electrical Transmission Apparatus for Causing the Movements of any Mechanism to be Exactly Repeated upon Distant Mechanisms. Evershed & Vignoles, Ltd., and S. Evershed. 13,874. July 5th.

Electric Quantity Meters of the Electrolytic Type. E. J. Piper. 14,050. July 7th.

Treblers for Electric Sparking Apparatus. Marconi's Wireless Telegraph Co. and E. Priddle. 16,656. August 16th.

Electrical Apparatus for Controlling the Working of Ordnance. A. T. Dawson and J. Horne. 16,724. August 17th.

Electric Switching Devices for Electric Accumulators. H. Stern and G. Engisch. 17,402A. August 28th. (Date applied for under Rule 5 Patents Rules, 1905, August 28th, 1905.)

Form of Electrical Contact-Breaker for Induction Coils. E. Payne 17,835. September 4th.

Combined Electric Switches and Automatic Circuit Breakers. J. H. Holmes. 17,888. September 4th.

Telephone Exchanges Working on the Central Microphone Battery System. H. Oppenheimer. (Akt.-Ges. Mix und Genest.) 18,312. September 11th.

Electric Stoves. O. C. Hawkes. 25,032. December 2nd.

Actuation of Magneto Electric Generators and Electric Contact Breakers for Use in the Ignition of Internal Combustion Engines. Dresdner Gasmotorenfabrik vorm. Moritz Hille. 25,502. December 7th. (Date applied for under International Convention, May 22nd, 1905.)

Electric Conduits. J. H. Sutton and L. Gregson. 27,224. December 30th.

1906.

Wireless Telegraphy. L. Wilson. 953. January 18th.

Automatic Electric Signalling for Use on Electric Tram, Railways, or the Like. C. J. Spencer. 1,695. January 23rd.

Electric Alarm Devices. A. Loebl. 1,728. January 23rd.

Speed Regulation of Single-Phase Commutator Electric Motors. B. G. Lamme. 2,604. February 2nd. (Date applied for under International Convention, February 6th, 1905.)

Electric Time Switch. H. E. Taylor. 4,331. February 22nd.

Holders for Incandescent Electric Lamps. W. P. Brooks and A. D. White. 4,808. February 27th.

Electricity Meters. O. Paulet. 4,951. February 28th. (Date applied for under International Convention, March 1st, 1905.)

Electricity Meters. O. Paulet. 4,951A. February 28th. (Date applied for under International Convention, June 6th, 1905.) Originally included in No. 4,951, 1906.

Apparatus for Electro-Therapeutic Treatment. M. C. A. Kroeger. 5,047. March 1st.

Electrical Advertising Devices. J. Gibson and A. Brooker. 7,663. March 30th.

Dynamo-Electric Machines. M. Milch. 7,919. April 2nd. (Date applied for under International Convention, April 3rd, 1905.)

Brush-Holders for Electrical Machines. G. Finzi and E. Tallero. 8,434. April 7th. (Date applied for under International Convention, April 8th, 1905.)